

## **Section 6: Customer Choice and Direct Access**

IN THE MID 1990s, the electric power industry was characterized as the “last surviving monopoly in the United States.” Advocates of deregulation like Representative Thomas DeLay called for ending “government-mandated monopoly production and pricing of electricity.” Their vision of a “free market” was based on what they saw as “time-tested economic principles: *customer choice*, innovation, and competition (emphasis added).” Competition was expected to lower the cost of electricity to all consumers. “In a competitive market (consumers) will pay less for their electricity because they will have the right to choose their electric service provider.” (Rep. Thomas DeLay, Heritage Lecture #582, April 8, 1997, [www.heritage.org](http://www.heritage.org).)

Traditionally, local electric companies provided their customers a complete package of services, from generation to delivery, at prices regulated by the California Public Utilities Commission (CPUC). This approach was changed by the implementation of California’s electric industry restructuring law (AB 1890) and a series of landmark decisions by the CPUC in 1996. To make “customer choice” possible, the investor-owned electric utilities were required to separate, or “unbundle,” their electric service bills into separate components and charge for energy and its delivery separately.

Once services were unbundled, customers could shop around and compare the prices offered by other electric power suppliers. In a process called “direct access,” electricity consumers were given the option to purchase their electricity competitively at prices determined solely between them and an alternative electric supplier. Or they could continue buying electricity from the local utility at prices regulated by the CPUC. Either way, the local utility continued to distribute the electricity at prices set by the CPUC. The local utility also continued to maintain the power lines and restore service following an outage.

### **History of direct access in California**

Direct-access programs began shortly after enactment of California’s electric industry restructuring law. Alternative electricity suppliers targeted different markets, including residential customers, government entities, commercial businesses with multiple facilities, and large industrial customers. Two kinds of customer choice emerged: business-targeted direct access, offering low-cost power; and environment-oriented direct access, offering higher-priced electricity exclusively from renewable-energy generating facilities. Residential customers comprised most of the participants in this green-power market. At the peak, more than 200 alternative electric service providers (ESPs) provided service to 200,000 California customers.

During the 2000-2001 electricity crisis, wholesale electricity prices spiked. For direct-access customers, prices were more than double what the local utility was charging. Drove of direct-access customers reacted by returning to their local utility for retail electric service, and most of the ESPs decided they were in the wrong business. (Investor-owned utilities had lower and more stable rates because residential and small commercial rates had been reduced 10 percent—and frozen—by AB 1890.)

Enron, a major alternative electricity supplier at the time, returned its direct-access customers to local utility service without these customers’ permission or knowledge. Local utilities accumulated significant debt buying high-priced power for existing customers as well as the large influx of returning (former direct-access) customers.

Some direct-access customers fared much better than others during the electricity crisis. For example, customers of Strategic Energy, LLC of Carlsbad, CA, had low and stable rates because this alternative electricity supplier had earlier secured long-term contracts with 126 separate generators from which it obtained its power and thus was not at the mercy of the wholesale spot market.

During the special session called to resolve the electricity crisis, the California legislature passed AB 1X, which assigned the California Department of Water Resources (DWR) the responsibility for buying electricity on behalf of the local utilities and their retail customers. Once DWR took over and negotiated new long-term contracts, electricity prices dropped and stabilized.

AB 1X also directed the CPUC to suspend direct access until DWR “no longer procures power for retail end-users.” Although AB 1X became law on February 1, 2001, the CPUC did not issue a decision to suspend direct access until September 20. The legislature had asked the CPUC to delay this decision so that it would have more time to find a way to preserve direct access, as requested by alternative electricity suppliers and their customers. During that delay, businesses were aware that suspension was imminent; nevertheless, alternative electricity suppliers were allowed to sign up new customers. Many businesses rushed to lock in lower priced electricity before the CPUC finally suspended direct access. Once direct access was suspended,

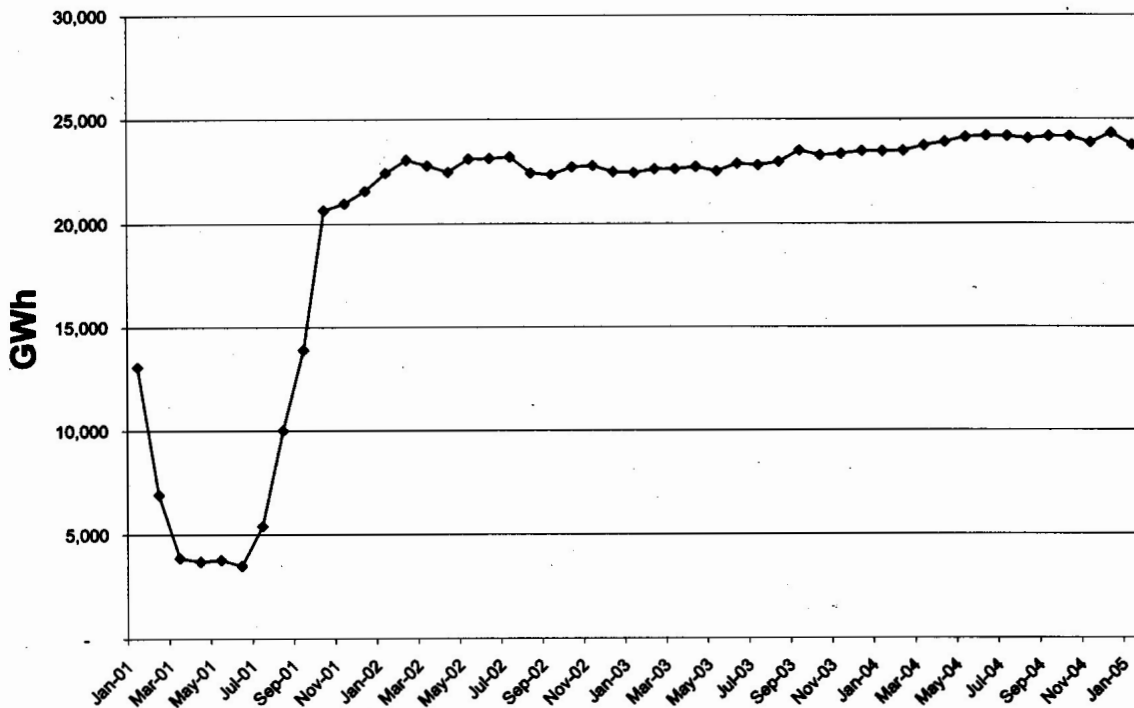


Figure 1: Total Statewide Electricity Sales to Direct Access Customers

alternative electricity suppliers could not sign up new customers, but they could honor all existing contracts.

DWR committed more than \$51 billion in contracts with merchant power generators in the short term and long term. The state had to repay an \$8 billion loan from the General Fund and finance \$43 billion worth of long-term contracts through the largest revenue bond sale in U.S.

history. Direct access was perceived as a “loophole” that must be closed so that potential investors would not question California’s ability to repay the bonds. In its September 2001 decision to suspend direct access, the CPUC stated, “Suspending the right to acquire direct access service will assist in issuing these bonds at investment grade, by providing DWR with a stable customer base from which to recover its costs...”

### **Current status of direct access in California**

The CPUC’s suspension of new direct access is still in effect, although customers with direct-access contracts can continue to purchase electricity from alternative electricity suppliers. They may even change suppliers, but their choice of electric service providers (ESPs) is slim. More than 200 companies originally participated in California’s electricity market as ESPs, but the energy crisis caused a big shakeout. Today, only 19 companies are registered with the CPUC, and half of these will do business with “large customers” only. More than 2,000 MW of load is still served under direct-access contracts.

Those direct-access customers who returned to local utility service during the electricity crisis and then left utility service again for direct-access service must pay an “exit fee” (now called a “cost responsibility surcharge,” or CRS) of 2.7 cents per kilowatt-hour to cover their portion of the higher cost contracts negotiated by DWR. Direct-access customers that remained so throughout the electricity crisis do not have to pay the CRS. In 2003 the California legislature passed AB 1284 (Leslie) that allows the CPUC to waive or defer a portion of the exit fee for direct-access companies who were returned to local utility service without their permission or knowledge, but who returned quickly to direct-access service.

If a direct-access customer decides today to return to local utility service, that customer must provide six months’ advance notice to the local utility. The purpose of this requirement is to enable the utility to adjust its procurement activities to accommodate the additional load. Furthermore, direct-access customers cannot increase their electric consumption beyond the amounts set forth in their supply contracts.

### **Community choice aggregation**

The legislature has also passed new laws that provide exemptions to the direct-access suspension. The cities of Cerritos and San Marcos were authorized to act as “community aggregators” for their residents who are in the Southern California Edison service territory. The reason for this exemption is that these cities are participating in the municipally owned Magnolia Power Plant expansion project. In addition, in 2003 the Legislature passed AB 117 (Migden), which allows cities and counties that choose to do so to aggregate consumers’ electric loads on an “opt-in basis.” Community aggregation is a form of direct access by which a municipality may act as a purchasing agent on behalf of its residents. “Community choice” aggregators are required to file an implementation plan with the CPUC and pay exit fees. Customers of community choice aggregators must also continue to contribute to the local utility’s public goods accounts for renewables, energy efficiency, research and development, and low-income programs.

Today, California is operating with a “hybrid” electricity market. Electricity is priced as a commodity, like natural gas and crude oil. The wholesale price of electricity fluctuates with changes in supply and demand. During times of peak demand, supplies are tighter and prices rise. During off-peak periods, electricity prices are low.

Consumers may react to higher electricity prices by cutting back on their use. If they don't cut back, however, sustained high prices and demand for electricity are a "market signal" telling generators to build more power plants.

Eighty percent of California's generation is now owned by non-utilities. Not only do generators choose when market conditions are right to build new electric capacity, they choose what type of power plants to build and where to build them. Because natural gas was plentiful and cheap throughout the 1980s and 1990s and was forecasted to remain so, nearly all of the new power plants licensed in California were natural gas-fired combined-cycle technology. Power plant siting was determined in large part by a location's proximity to natural gas pipelines. Over-reliance on natural gas for electricity generation is a concern, since natural gas supplies are now tight and expensive. Furthermore, some of the new plants were sited in areas where electric transmission is limited, leading to increased congestion of the grid.

Prior to electric industry restructuring, local utilities built and owned power plants themselves, or they signed long-term contracts with independent power generators. In both cases, however, the local utility was guaranteed that its investments would be reimbursed as part of the cost of service. In the eight years since restructuring, the Energy Commission has licensed 53 new power plants, but many have not been built, due to private investor reluctance to finance them. Power plant construction is now financially risky because utility ratepayers are no longer the guaranteed markets for these plants.

#### **Energy Commission Projects (1998-2005)**

Projects approved and on-line	25	8,458 MW
Projects approved and under construction	13	5,202 MW
Projects approved and available for construction	11	8,173 MW
Projects whose licenses have expired	4	393 MW
<i>Total projects approved post-restructuring</i>	53	22,226MW

*Source: CEC notice April 18, 2005*

#### **Impact of direct access on utility resource planning**

In 2005 the CPUC adopted "long-term procurement plans" prepared by the state's three investor-owned electric utilities. These plans are based on each utility's 10-year forecast of electricity demand growth in its service area. The utilities plan to buy enough electricity to meet anticipated demand, plus a 15 to 17 percent planning reserve margin to ensure electric service reliability. Ensuring system reliability and resource adequacy are California energy policy makers' top priorities.

Community-choice aggregation (CCA) and the potential for lifting the current ban on new direct-access contracts create considerable uncertainty as to the amount of load (i.e., customer demand for electricity) the existing utilities will be responsible for serving in the future. If customers depart from the local utility to buy electricity from a different provider, then the utilities could end up "over-procuring" power resources and incurring the "stranded costs" associated with these resources. The utilities are concerned that the CPUC may not allow them to recover these costs from ratepayers.

The CPUC's response has been to suggest that the investor-owned utilities' procurement portfolios contain "a mix of resources, fuel types, contract terms and types, with some

baseload, peaking. . . and intermediate capacity, and with a healthy margin of built-in flexibility and sufficient resource adequacy.”

The CPUC encouraged cities and counties that were seriously considering CCA to approach their local investor-owned utility and discuss procurement strategies, such as having the utility allocate some of its supply contracts to the CCA once it is formed.

The utilities’ potential loss of large industrial and commercial customers to independent merchant generators through direct access is also a problem, because the pattern of use by these customers (their daily “load profile”) is typically flat, while the utility’s focus under the long-term procurement plan will be on buying electricity to meet its peak demand. The utility won’t be buying much baseload capacity (used to serve flat load profiles) until the long-term contracts negotiated by DWR expire. The CPUC acknowledged this problem in its *Proceedings 04-04-003*, by noting “a potential mismatch between the types of resources that the utilities need to procure (i.e., peaking and load following) and the resources that departing customers require (i.e., baseload with lesser amounts of peaking and load following capability).” Thus it may not be possible for the utility to develop a resource portfolio that accurately matches the load profile that would result from significant additional departing load.



## Section 7: Interrelationships of Energy and Water

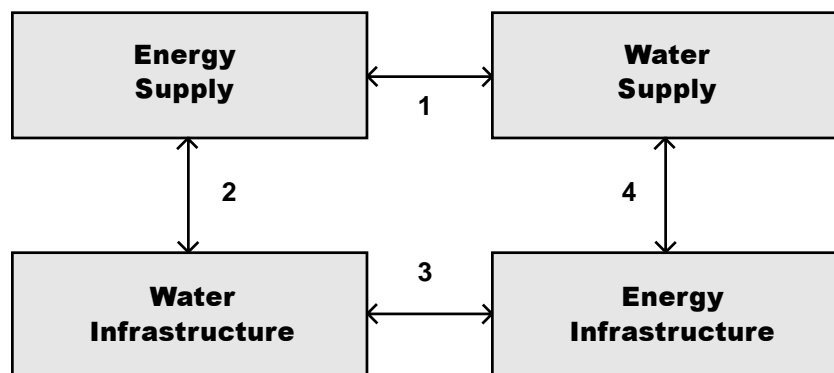
GREAT AMOUNTS OF ENERGY ARE REQUIRED to provide clean water to Californians, and to treat that water after it is used. The California Energy Commission (CEC) estimates that the energy needed to distribute, treat, heat, cool or pressurize the water used by Californians is nearly 20 percent of the total consumed in California—more consumption than any other use of energy in the state. Nor is this all: Electricity use by the water sector could nearly double by 2015, far outpacing population growth. Some of this involves the large amounts of natural gas used to heat water. Irrigation pumping is generally not metered, but this use alone may require as much as 4,500 MW of generation capacity—and it is concentrated during the peak power months. In turn, most thermal power plants use large amounts of water for cooling, and may pollute the water so used.

Since burning fossil fuels produces greenhouse gases, electric generation is a factor in climate change. This is predicted to have major consequences on water availability. The Sierra snow-pack, which holds more water than all the lakes and reservoirs in the state, historically melts in the late spring and summer when the reservoirs begin to become depleted. Early melting will likely mean that already-full reservoirs cannot capture much of the runoff.

Water is also an important source of power. Hydropower provides between 12 and 18 percent of California's total energy production, depending on the annual precipitation. Installed hydro capacity in the state amounts to 8,740 MW. Hydro facilities are licensed by the Federal Energy Regulatory Commission (FERC) for 30 to 50 years. At present, the licenses of 44 projects totaling nearly 5,000 MW will expire in the next decade. These projects were first licensed long before the establishment of rigorous environmental standards, and some of them probably will not receive new licenses. Others will require major retrofits.

Hydro facilities, including pumped storage, can be started rapidly and are thus an attractive option for load following—picking up the load when intermittent generation, such as wind or solar, decreases. It is becoming increasingly clear that there are innovative ways to add additional modular pumped storage units along the state's extensive water conveyance system.

### The water-energy relationship



1. Energy is used to collect, convey, treat, and use water, and to treat and dispose of wastewater. Water is used to produce energy, both as a fuel (e.g. hydropower) and for cooling power-generation combustion processes.
2. Water infrastructure needs energy to process and transport water and wastewater; energy needs water infrastructure to deliver water used in energy production.
3. Water and energy infrastructure are used by each other, and often share routes and trenches.
4. Water is used by energy infrastructure (e.g., cooling).

*Source: California Energy Commission*

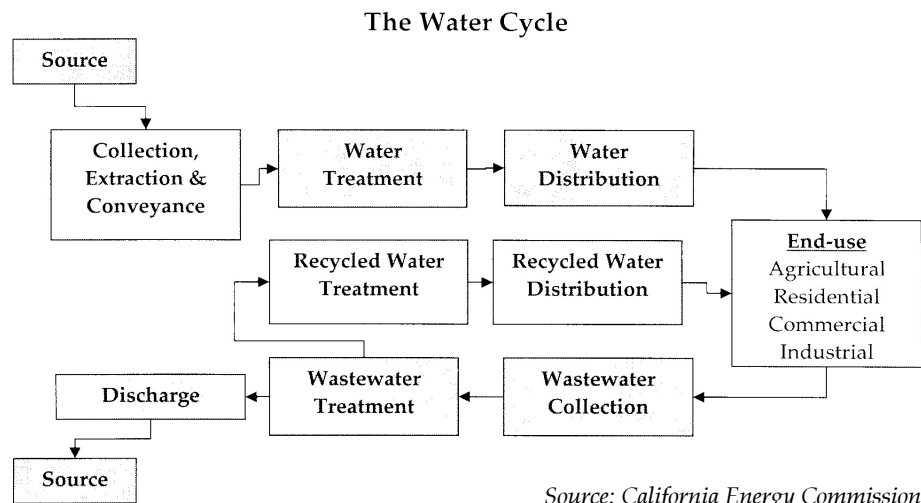
For all these reasons, energy and water are thoroughly and inextricably interrelated. Yet California today has neither a mechanism nor a clear mandate to integrate their planning and management. The CEC has been addressing the linkage in the 2005 Integrated Energy Policy Report. Work at UC Santa Barbara and the Pacific Institute is directed to establishing the energy demands of different uses of water, and to accurately assessing energy demand in the water sector. The CEC is also exploring ways to reduce on-peak and total electric demand through water conservation and improvements in energy efficiency. These efforts will help guide both the future planning and regulation of the water-energy relationship in the state.

**Water use**

“Energy-intensity” is the term used to describe how much energy is expended in using a defined amount of water in a specific situation. This encompasses all the energy required to get the water to the place of use and to treat, heat or cool it. Energy-intensity varies with source, use and location. It is a complex topic, and relatively few people are aware of its significance. For example, many people don’t stop to think that washing clothes in cold water is notably less energy intensive than washing in hot water. Understanding the energy-intensity of specific water use decisions is the first step toward energy savings.

**Source and conveyance**

The principal sources of water, in California as nearly everywhere, are surface water, ground water, recycled wastewater and water from desalination plants. Some water is used locally, much is conveyed elsewhere. Broadly stated, the greatest rain and snowfall occur in the northern part of the state and the greatest consumption occurs in the south. This has great political significance. Furthermore, it is significant, also, because transporting water south (or anywhere) in open canals and aqueducts means that a considerable amount of it is lost through evaporation.



**Surface water**

Surface water includes natural lakes and rivers, and constructed reservoirs, canals and aqueducts. It comprises about 70 percent of the water used in California, either locally or conveyed elsewhere by gravity or pumping. California has nine major human-made surface water projects.

The largest such project is the State Water Project (SWP) which moves water from the Feather River and Lake Oroville to the Central Valley and southern California. Pumping SWP water south takes about 12,200 GWh of energy each year. At points where water in the aqueducts

returning to a lower elevation passes through a turbine, its eight hydropower generating plants produce about 7,600 GWh. That makes it a net user of about 2 to 3 percent of all electricity used in California. The SWP, like all hydropower producers, is subject to the vagaries of rainfall. And, like nearly all of them, it is continually looking for ways to reduce energy consumption.

The federal Central Valley Project (CVP) delivers water from Redding to Bakersfield and points between. Most of this water goes to farms in the San Joaquin Valley. The CVP is a net power producer, with a pumping load of about 600 MW and a power production capacity of 1,200 MW.

The Colorado River Aqueduct brings water from Lake Havasu in Arizona to Southern California. Although there are three major hydropower facilities on the Colorado River—the Hoover, Parker and Davis dams—this project is a net energy user within California. The other major surface water projects are two segments of the Los Angeles Aqueduct, the Mokelumne Aqueduct, the Hetch Hetchy Regional Water System, the All American Canal System, and the Coachella Canal.

Building new dams or raising existing ones is one way to provide energy as well as store water. But in each instance the relative implications of water and energy must be balanced. In addition, new surface water facilities will inevitably have environmental implications, including drastic changes in ecosystems, loss of habitat and loss of resources of environmental value. Raising the level of Shasta Dam would cost the least, because it is on an existing river and has the potential to generate much more electricity, but the energy costs to pump water to Southern California will continue to be very high. The Metropolitan Water District (MWD), the largest district in Southern California, estimates that the electricity used to deliver water to Southern California is equal to one-third of the total household electric use there. Thus, MWD is always interested in any nearby sources of additional supply.

### **Groundwater**

About 30 percent of the water used in California comes from underground, and the state is currently withdrawing more than is being put back. Agriculture is the big user of groundwater (85 percent; urban usage is around 15 percent) except in years of serious drought. Groundwater is generally used in the immediate local area. There are about 450 groundwater aquifers across the state, which have a capacity many times greater than the state's surface water storage. Most of these aquifers give evidence of significant overdrafting. As the level of water in an aquifer falls, the energy used for pumping increases. Because groundwater is not generally measured or regulated and pumping is not effectively metered, it is difficult to estimate either overall energy use or overall water quantities. Steve Shaffer, director of the Office of Agriculture and Environmental Stewardship at the Department of Food and Agriculture, has referred to groundwater use in California as an unmetered "black hole," through which an estimated one million acre-feet disappears annually.

Although more water is currently being drawn from underground than nature and humans together are putting back, artificial recharge of ground water is increasing. Water from spring runoff in wet years, as well as some water from wastewater treatment plants, is being channeled into depleted aquifers to meet future needs. This is an increasingly popular technique, but it comes at a notable energy cost—the need for additional pumping.

A particular concern associated with groundwater depletion and the associated energy use is the increasing use of drip or spray irrigation. There has been a significant shift from commodity crops to specialty crops, with increased emphasis on more sophisticated irrigation

patterns. The newer systems are pressurized, which means they require more energy, and they are definitely more dependent on groundwater pumping. The use of pressurized irrigation is expected to increase over the coming decade, with increased demands on peak power.

### **Conservation as a source of new water and energy**

Conservation of water is both a water and an energy resource. In the urban sector conservation is required (not voluntary) in the sense that urban districts may not receive grants or state funding unless the district meets BMP standards as defined by the California Urban Water Conservation Council (CUWCC). But membership in the CUWCC is voluntary. Agricultural water users have the option (voluntary) to become members of the Agricultural Water Management Council, which requires certain conservation measures of its members.

Much more can be accomplished in the future. At this point there is great variability between existing energy and water efficiency programs as well as with regard to their regulatory oversight and compliance. Nevertheless, broad acceptance of Best Management Practices (BMP) and other conservation measures have the potential to promote real savings.

At present, \$180 million of Proposition 50 funds has been allocated to support water efficiency programs in years 2003 through 2007. (This contrasts with an average of \$286 million being spent annually on energy efficiency programs.) The Proposition 50 funds are to be divided between urban use, agricultural use and water recycling. Specific programs that are being funded include residential plumbing retrofits; installation of meters for new connections, including landscaping; rebates for high-efficiency washing machines; and large landscape conservation programs.

### **Desalination**

Desalination involves separating out the minerals in salt, polluted or brackish water, to render it suitable for new use. Two different technologies can be used. The first is similar to the distillation process that we all experimented with in high school chemistry lab—“evaporating” polluted water and then recondensing it in another location without the pollutants. The second technology, currently more popular, is membrane separation: membranes with openings only large enough for small molecules are used to separate the small water molecules from the larger pollutant molecules. Both technologies are energy intensive. Due to high energy and technology costs, less than one percent of California water is currently provided by desalination. Although the technology is improving, energy use is 40 percent of the total cost. Because it has fewer pollutant molecules to filter out, thus requiring less energy, brackish water is generally the preferred option for desalination.

About two dozen desalination plants are proposed along the California coast at this time. Most of these would supplement local supply. While desalination facilities may have adverse environmental impacts including killing of larval fish, they may also provide benefits beyond supplementing local water supply. Used to offset use of surface water, they could provide ecosystem benefits when water is left in surface streams and rivers. They are independent of the weather—water can be produced even in dry years—and flexible; they could also help improve water quality.

Desalination has the potential to provide overall energy savings if used strategically to supplement other water supplies. On the other hand, plants whose costs are recovered through long-term contracts would be expected to normally run at maximum capacity, resulting in increased energy use. A further consideration is that the salt residue remaining after desalination may be considered a hazardous material, presenting a disposal challenge.

## **Water recycling**

A significant source of “new” water is recycling—treating once-used water for direct reuse. Costs vary depending on the intended reuse (water for human consumption will require more treatment than water for irrigation, and is therefore a more expensive and more limited use) and how far the water must be transported. While the use of recycled water is less costly and less energy intensive than desalination, the cost and energy requirements for implementation of dual plumbing need to be factored in. Recycled water has been most successful in Southern California, especially where dual piping could be installed as part of the initial construction, as was done at Irvine Ranch. Issues related to recycled use for crop irrigation are being addressed by the U.S. Environmental Protection Administration. Most new golf courses in the state are being watered with recycled water, and in many coastal communities, injection of recycled water is minimizing the intrusion of salt water into groundwater aquifers. At present there are more than 300 water recycling plants in California.

The major energy cost for treating recycled water is in pumping it to the treatment plant and from the plant to the point of use. These costs have been reduced through the use of variable-speed pumps. But as new pollutants such as pharmaceuticals and pesticides challenge current treatment standards, and technological advances in treatment such as ozonation or UV become more common, the energy required for treatment is expected to increase significantly.

## **Local distribution**

After water has been treated, the principal energy required to distribute it to the end user is for pumping. Costs vary greatly, depending on the location and age of the system, and of course on how much water can be delivered by gravity flow. Energy can be saved by installing automated systems and upgrading old piping to reduce losses.

## **End users**

Californians use vast amounts of water, and this is cause for concern. The amounts are enormous: urban users (residential, commercial, industrial and institutional) alone use about seven million acre-feet annually, enough to cover all of Connecticut more than two feet deep.

Low water rates charged many Californians do not provide incentives to save; rates in many heavy-use areas remain fixed. Many multiple-family dwellings throughout the state have just a single meter for an entire building, giving little incentive for individual users to save. Many homes in the Sacramento and some San Joaquin Valley areas do not even have meters. Marin Municipal Water District instituted an inverted rate structure for water last year, but other water districts have shied away from this political “hot potato.”

Half the state’s commercial, industrial and institutional water demand is used for cooling and heating; these sectors also use waste water for industrial processing, washing, and as a direct ingredient. Few figures are available on water-related energy use in the industrial sector, since energy requirements are aggregated for each facility. During drought years in the ’80s and ’90s, food processing plants and metal plating industries adopted membrane separation technologies to reuse water onsite; this reuse is associated with an increased energy demand, though in some instances the water usage was decreased by 95 percent.

It is agriculture that uses the great bulk of the state’s developed water supply—an estimated 80 to 85 percent or more (we haven’t calculated what *this* would do to Connecticut!). Up to 90 percent of electricity on farms is used for groundwater pumping, and much of this is unmetered. For areas using surface water supplies, pumping costs are significant as well.

## **Where is energy best saved?**

The best way to reduce water-related energy costs is to reduce water use: there will be savings at the point of use and at all “upstream” stages as well. Because conserving water in areas of high energy-intensity will bring the greatest energy savings, energy-intensity must be adequately evaluated for all aspects of the water cycle, since it can vary by location and use. Opportunities for the safe use of treated “gray” water should be identified—except for conservation, water reuse is the least energy-intensive source of water.

## **Future drivers/challenges in California**

With its large and growing population, California faces major challenges in reducing the energy consumed in distributing and using its large but limited supplies of water. Many facilities were built before energy consumption became a major concern. It will be a challenge to retrofit them to be energy efficient.

New, or newly recognized, sources of pollution such as pesticides and pharmaceuticals are likely to require additional, energy-intensive treatment. The energy, air quality and environmental consequences of water conveyance will become more complex as the value of water and the demand for environmental restoration both increase.

Federal, state and local regulators will be challenged to integrate energy-intensity into their water resource planning and end-use policies. Some cases may require creative financing and technology to provide energy saving while keeping the projects economically viable.

One potentially huge concern about which few hard facts are available is climate change. In California this is likely to mean more rain and less snow. Because the state relies heavily on the water held in the snow pack for both energy production and water supply, less snow could mean greater dependence on desalination and ground water, with a resultant increase in energy requirements among other, quite possibly even more serious, effects.

## **Potential solutions, current agreements/regulations**

The best way to reduce water-related energy costs is to reduce water use. Mentioned above, this vital point bears repeating. For reduced water use to come about, it is clear that better integration of energy and water policy and planning is needed at all levels, federal to local. Specific areas that should be addressed can be summarized as follows:

### **1. Water resource planning**

- a. Provide consistent data on the energy-intensity of water supply systems and assure that the data are available to planners
- b. Include energy-intensity in the planning and analysis of conveyance and water end-use projects
- c. Include energy use in water resource planning
- d. Account for water resources in energy planning (e.g., use of steam for enhanced oil recovery, water to cool thermal power plants)

### **2. Water conservation**

- a. Require that all water use be measured, including groundwater and wastewater
- b. Encourage water pricing policies that reflect the true cost of water
- c. Improve compliance with existing water conservation agreements (e.g., the Memorandum of Understanding Regarding Urban Water Conservation in California)
- d. Provide incentives/disincentives and public awareness to encourage water conservation.