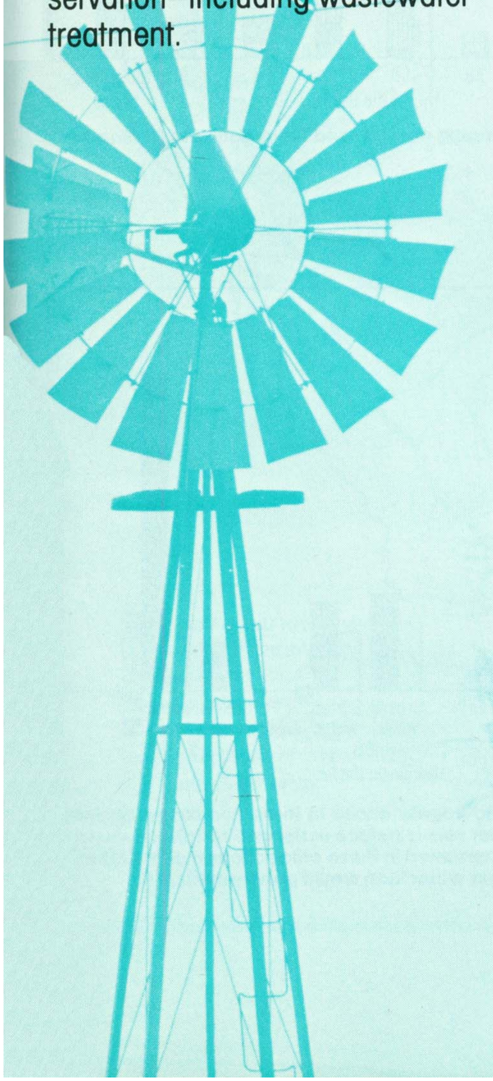
Energy

Energy and water are inextricably linked. It takes immense amounts of energy to pump water and transport it through California's vast system of canals. Falling water can create large amounts of hydroelectric power, while thermal power plants use large amounts of water for cooling. The economic relationship between water and energy is so close that trade-offs are both unavoidable and highly complex.

Recent U.C. research includes two aspects of the water/energy relationship: energy needs for agricultural uses of water and energy requirements of alternatives for water development, use, and conservation—including wastewater treatment.



Can irrigation with municipal wastewater conserve energy?

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In response to California's need for water, to public concern about conservation, and to a legislative directive, the State Water Resources Control Board has developed a policy and action plan for reclamation and reuse of wastewater.

Approximately 80 percent of the potential for reclamation in California is in basins where wastewater is being discharged to brackish or saline water—mainly the Pacific Ocean. (Most wastewaters from inland basins already are being discharged to local streams or ground-water basins, hence are made use of by adjacent or downstream users.)

One of the expected benefits of wastewater reuse is energy savings in those situations where reuse is an alternative to importation of fresh water. Unfortunately, however, geographic and water-quality considerations may limit the energy benefits of irrigation with wastewater in many of the situations with the greatest potential for wastewater reclamation.

In the greater Los Angeles area, for example, water imported from the Colorado River requires about 2,075 kilowatt-hours per acre-foot (KWH/AF) for pumping. Water imported through the fully developed State Water Project (after year 2020) will require 2,767 to 3,292 KWH/AF, depending on delivery elevations.

Two important questions, then, are: (1) Would reuse of wastewater on farmland require less energy than discharge to the ocean? (2) If so, would it require more or less energy than importation of fresh water for irrigation? Municipal wastewater discharged to the Pacific Ocean requires considerable energy for secondary treatment (biological oxidation and assimilation of organic matter) and pumping through a long ocean outfall. Since wastewater reused for irrigation of fodder, fiber, and seed crops requires only primary treatment (screening and settling processes), each acre-foot reused could save about 200 KWH in direct energy requirements—compared to ocean disposal—by eliminating the secondary treatment and ocean outfall pumping. Under current health regulations wastewater reused for pasture irrigation and surface irrigation of food crops requires secondary treatment. Therefore reuse instead of ocean disposal would save only the approximately 50 KWH otherwise required for outfall pumping. Wastewater reused for sprinkler irrigation of food crops requires secondary treatment plus chemical coagulation and filtration. Such reuse would require slightly more direct energy—possibly 10 KWH/AF—than ocean disposal of the wastewater.

When only these direct energy requirements are considered, it appears that irrigation with wastewater could save very large amounts of energy compared with importing fresh water. However, elevation and quality differences tend to offset the benefits. Adequate cropland for large-scale irrigation reuse of wastewater from the Los Angeles area is many miles inland and at higher elevations. Also, municipal use typically raises the salt concentration of water by about 350 ppm, and the greater salt concentration may reduce crop yields. To be fully comparable with fresh water, wastewater must be of equal quality and be delivered to the same elevation.

For illustration purposes, assume that the available fresh water consists of a 50:50 blend of Colorado River and State Project water for an average total dissolved solids (TDS) concentration of 500 ppm and an average delivery elevation of 1,500 feet. In this case, the average energy required is about 2,550 KWH/AF. The TDS concentration of the municipal wastewater is assumed to be 850 ppm. If this wastewater is pumped to 1,500 feet elevation and blended with State Project water to reduce the TDS concentration to 500 ppm, the average energy required for the blend will be about 2,400 to 2,500 KWH/AF—saving very little energy in comparison with the 100 percent imported water.

Conversely, at certain inland locations, direct irrigation with wastewater may save energy even though the wastewater otherwise would be discharged to rivers and reused. This can occur where a river is officially designated as a "water quality limited stream segment" so that nitrogen and phosphorus removal and possible other tertiary treatment processes must be applied along with secondary treatment before wastewater can be discharged to the river. Applying this wastewater to a fodder, fiber, or seed crop can save energy by avoiding the need for secondary and tertiary treatment.

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