



Reducing Greenhouse Gas Emissions Through Improved Water Policy

Most people are surprised to discover that water use in California is extremely energy intense. Today, more than 19% of electricity, 32% of non-power plant natural gas and 100 million gallons of diesel fuel are used to treat, deliver and heat water in California each year.ⁱ E2 has quantitatively evaluated the connections between energy and water and we believe that by 2020 California can reduce its GHG emissions by up to 7 million metric tons of CO₂ equivalents per year (MMT_{CO2E/yr})ⁱⁱ by implementing the energy efficiency and water efficiency programs summarized below:

	Water Saved (AF/yr)ⁱⁱⁱ	Electricity Saved (kWh/yr)	Natural Gas Saved (MT/yr)
Basic Conservation			
Residences, Indoors ^{iv}	857,000		
Residences, Outdoors ^v	470,000		
Businesses, Institutions, Indoors & Outdoors ^{vi}	980,000		
Meters and Tiered Pricing ^{vii}	330,000		
Established Solutions			
Solar Water Heating ^{viii}	N/A		248
Non-Revenue Water, Urban ^{ix}	140,000		
Centralized Water Recycling ^x	1,000,000		
Biogas to Energy at Wastewater Facilities ^{xi}	N/A	37,000	
Drip Irrigation for Agriculture ^{xii}	1,300,000		
New Solutions			
Optimization of Processing Plants ^{xiii}	N/A	880,000,000	
Smart Water Technologies, Urban ^{xiv}	51,000		
Emerging Technology			
On-site Water Recycling ^{xv}	92,000		
Total Saved	5,220,000	880,037,000	248

Proven and emerging solutions for water efficiency can save California approximately 5.2 MAF of water each year -- saving both valuable water and reducing GHG by approximately 5.35 MMT_{CO2E/yr}^{xvi}. In addition, direct annual reductions of 880 MWhr of electricity and 248 million therms (MT) of natural gas will save at least .3 and 1.3 MMT_{CO2E/yr}, respectively, for aggregate water-related energy savings of approximately 7 MMT_{CO2E/yr}. Our conclusions may be understated because: (1) we have assumed that 7 MAF is used in the urban environment, whereas CDWR estimates that 9 MAF^{xvii}, a 22% difference, (2) we use the CAT conversion factors for estimating GHG reductions from natural gas and electricity; however, those factors are very conservative, and (3) we have not accounted for any increase in water use due to increased population between now and 2020, whereas CDWR assumes significant growth



ENDNOTES

ⁱ Overall energy to distribute, process, heat and treat water is estimated at 48,000 GWh (Giga watt hours), 2,375 MTh (million therms) and 100 million gallons of diesel fuel. See California Energy Commission (CEC), 2005 Integrated Energy Policy Report, CEC-100-2005-007CMF, Sacramento, November 2005, pg. 150, (**hereinafter cited as IEPR-2005**); CEC, *California's Water-Energy Relationship*, Final Staff Report prepared in support of IEPR-2005, CEC-700--2005-011-SF, Sacramento, November 2005 (**hereinafter cited as CEC-2005**); and Wolff, G. and Wilkinson, R., *Statewide Assessment of Water-Related Energy Use*, The Pacific Institute and The Water Policy Program at UCSB, prepared for the CEC PIER Program, draft report dated June 2006, pg. 8 (**hereinafter cited as Wolff-2006**).

ⁱⁱ The California Climate Action Team estimates that each MWh of electricity is approximately equivalent to .345 MMTCO₂E, based on average electricity generation across California. Economics Subgroup Climate Action Team, *Updated Macroeconomics Analysis of Climate Strategies Presented in the March 2006 Climate Action Team Report*. Final Report, October 2007, p.13. (**hereinafter cited as CAT-2007**). When burned, natural gas emits 116.73 lbs of CO₂ per MMBTU, resulting in approximately 189 million therms of natural gas for each MMTCO₂E. See CAT-2007, p.13. Wolff-2006, p.11 estimates that an average of 1.03 MMTCO₂E is reduced for each statewide average million acre foot of water that is conserved.MMTCO₂E.

ⁱⁱⁱ Current water use in California is approximately 43 million acre feet (MAF). See California Department of Water Resources (CDWR), Bulletin 160-05. *California Water Plan, Update 2005*. Volume 1, Chapter 3, pg. 3-9 (**hereinafter cited as CDWR-160-05**). One acre-foot is equal to 435.6 hundred cubic feet (ccf), or 325,851 gallons. Each reference to AF refers to acre feet of water.

^{iv} This estimate assumes a base level of indoor residential conservation of 893,000 AF/yr, as estimated by Gleick, P., Haasz, D., Henges-Jeck, C., Srinivasan, V., Wolff, G., Cushing, K., Mann, A., "Waste Not Want Not: The Potential for Urban Water Conservation in California", The Pacific Institute, Oakland, November 2003, p. 40. (**hereinafter cited as WNNW**). This report differs from WNNW in that (1) we assume an installed base of approximately 26.5 million toilets, as described in J. Koeller, Koeller and Associates, *High-Efficiency Plumbing Fixtures, Toilets and Urinals*, Nov. 2005, pp. 6-9 (**hereinafter cited as Koeller-2005**), (as compared to the WNNW estimate of an installed base of 34.4 million toilets), (2) whereas WNNW assumes that 100% of new toilets will be 1.6 gpf toilets, we assume a combination of standard non-efficient toilets (greater than 1.6 gpf), 1.6 gpf toilets, 1.28 gpf HETs toilets, .5-1.0 gpf pressure-assisted models and 0.8-1.6 dual flush models as described in Koeller-2006 pp12-14 and (3) instead of assuming that no savings are available from faucet-related conservation, we assume conservation programs targeted at reducing faucet waste can achieve 20% savings (84,000 AF/yr) of the 423,000 AF/yr faucet usage estimated in WNNW p. 5.

^vWNNW, p.7.

^{vi} For outdoor conservation in the Commercial, Industrial and Institutional (CII) sector, we rely on WNNW, Appendix D, pp. 10-11, table D-17, which estimates that 615,000 AF/yr is used for CII landscape irrigation with a potential savings of 50%, or 307,500 AF/yr. For indoor conservation in the CII sector, we rely on WNNW p. 89, but we differ from WNNW because we assume that all new toilets are HET models with an average 1.0 gpf (rather than 100% 1.6 gpf models), that all new urinals are 0.26 gpf HEU models (rather than 1.0 gpf models) and that by 2020 all existing non-efficient toilets (using more than 1.6 gpf) are replaced by 1.0 gpf HETs, and all existing non-efficient urinals are replaced by 0.26 HEU models. See Koeller-2005, pp.14-17. After giving effect to Koeller's analysis, we estimate approximately 673,000 AF/yr can be conserved indoors in the CII sector, whereas WNNW estimates 668,000 AF/yr of savings.

^{vii} This estimate assumes 12% savings (in excess of all other urban savings described in this report) for urban users who newly adopt tiered pricing. See WNNW, pp. 74-75.

^{viii} This estimate represents the economic potential savings reported by Fred Coito and Mike Rufo, KEMA-Xenergy, Inc. for PG&E, "California Statewide Residential Sector Energy Efficiency Potential Study" Section 9.3.2, Table 9.2, April 2003, and, "California Statewide Commercial Sector Energy Efficiency Potential Study", May 2003.

^{ix} Actual NRW losses cannot be eliminated entirely; however, they can be significantly reduced, as evidenced in both Singapore and the South Nevada Water Authority (SNWA). See <www.snwa.com> for a detailed example of how to reduce NRW losses in a well-maintained and well-managed system. Each of Singapore and SNWA lowered their NRW to 6%. We assume that California can reduce its urban NRW losses from 10% to 8% of urban water, resulting in an overall savings of 2% of California's urban NRW.

^x CDWR, Recycled Water Task Force. *Water Recycling 2030: Recommendations of California's Recycled Water Task Force*. Sacramento. June 2003. p.14. <http://www.owue.water.ca.gov/recycle/docs/TaskForceReport.htm>.

^{xi} Simons, G. and Zhang, J., "Distributed Generation From Biogas in California" presented at the Interconnecting Distributed Generation Conference. CEC. March 2001, slide 13.

^{xii} This estimate assumes that users of 20% of agricultural water who do not currently use drip irrigation (34.2 MAF less 12 MAF, or 35%) will deploy it by 2020 and save at least 30% of the water used prior to such deployment, thereby generating 6 percent overall savings on the 22.2 MAF of agricultural water that is not currently subject to drip irrigation.

^{xiii} Electric Power Research Institute, Summary Report for CEC Energy Efficiency Studies, Palo Alto, 2001.

^{xiv} This estimate assumes that users of 20% of CII and Residential outdoor water take advantage of one or more Smart Water Application Technologies (SWAT) by 2020 to gain 20% water conservation above other efforts. SWAT solutions include commercially available soil moisture and rain sensors, where water savings with good turfgrass quality have been estimated to range from 11% to 28% and evapotranspiration controllers, where savings have been estimated to range from 36% to 59%. See Shedd, M., Dukes, M. and Miller, G. *Evaluation of Evapotranspiration and Soil Moisture-based Irrigation Control on Turfgrass*. Paper presented at ASCE EWRI World Environmental & Water Resources Congress. Tampa, Florida. May 2007. P.1.



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^{xv}This estimate assumes that users of 15% of the indoor water used in the CII sector (estimated by WNNW to be 1,900,000 AF/yr, less savings of 672,500 AF/yr from indoor conservation) will adopt on-site wastewater recycling and obtain 50% conservation by reusing such recycled water for irrigation, toilet water and selected industrial uses.

^{xvi}Based on an estimated the average statewide energy intensity of water of approximately 9,750 kWh and 3,500 kWh per million gallons for average statewide urban and agricultural water use, respectively. Actual energy savings depend on the mix of water use between Northern and Southern California, and between indoor and outdoor use

^{xvii}CDWR 160-05, p. 3-9.

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