Water is More Precious than Gold: Material Intensity in Water Use

Before discussing water savings, we need to define what we mean by "use". The EPA refers to withdrawal and consumption. Withdrawal is the amount taken from surface water and the water table. Consumption refers to the amount chemically combined with something (so that it is no longer fresh water) or evaporated. Water discarded instead of consumed is referred to as "returns", because it is supposedly reusable. This does not even approximate the impact of water use.

One example the EPA gives is power plant cooling. The water is withdrawn, and used to cool the plant. A little evaporates; and the rest returned (still more or less clean) to the source. This overlooks a certain amount of impact (fish killed during withdrawals, aquatic plant, fungal and microbial growth encouraged by the change in water temperature), but is basically correct. However they apply the same logic to water used for irrigation. With very few exceptions, irrigation water "returns" are loaded with fertilizer salts, growth hormones, microbes, and often pesticides and herbicides as well. Even runoff from organic farms usually contains salts from the manure and composts used.

So the proper way to count water is consumption, plus polluted returns - in most cases all withdrawals. The table below translates standard EPA figures into real consumption number[72]:

EPA Classification	**Withdrawals (%)**	**Consumption (%)**	**Withdrawals (millions of Gallons)**	**Consumption (millions of gallons)**	**Consumption + polluted returns = use (millions of gallons)**	**% total use (excludes clean returns)**
Irrigation	40%	81%	137,000	76,200	137,000	66.38%
Thermoelectric cooling	39%	4%	131,000	3,500	3,500	1.70%
Industrial + mining	8.2%	5%	27,800	4,500	27,800	13.47%
Domestic	7.5%	6%	25,300	5,900	25,300	12.26%
Commercial	2.4%	1%	8,300	900	8,300	4.02%
public uses and losses (clean returns)	1.6%		5,500	0	0	0.00%
Livestock	1.3%	3%	4,500	3,000	4,500	2.18%

Note that by any classification, the single largest use of water in the U.S. is irrigation - around two thirds of total water consumed or polluted. The following table includes selected methods of water conservation:

Water Savings		
Row Crops		
30%-50% from converting to no-till, 25%-30% locating crops appropriately. Withdrawals are reduced by about 48%, but polluted returns by much more.	50%	as described in previous section *Fields of Barley, Fields of Gold: Material Intensity in Agriculture*
Convert all less efficient irrigation to low-energy precise application micro-sprinkler, drip irrigation, subsurface irrigation and other ultra-efficient irrigation methods	33%[73]	
Since drainage required for no-till anyway, capture, filter, recycle and reuse run-off	27%[74]	
Row Crops	*75%*	
Buildings – Domestic and commercial use		
Residential Buildings	50%	*A Very, Very Fine House: Saving Energy in Residential Buildings*
Commercial Buildings	50%	Most of the savings possible in residential pay back even more in commercial buildings.
Rainwater capture + Greywater/ blackwater separation with Greywater treatment and reuse + super-efficient commercial toilets (heavier use allows us to spend more and recover those costs in water savings.)	50%	Blackwater treatment can be done on smaller scale – single commercial building or residential neighborhood/apartment complex
Total savings in buildings	*75%*	
Industrial water use savings		
Computer chips: more efficient filters[75],reduction in output waste combined with recycling[76], slowing speed of rinse processes[77]	80%-95%	
Other industries, similar savings in subsequent sections of this chapter	80% +	
Total water savings in industry	*80%+*	
Total savings in livestock watering	*~none*	
Total savings in thermo-electric cooling	*~none*	
Total savings in water for firefighting and other public uses.	*~none*	
Total water savings	**~72%**	**Thus around 40% energy saving**

End Notes

[72] United States Environmental Protection Agency, *How We Use Water In These United States*. 18/March 2003, United States Environmental Protection Agency, 06/Jul/2005 <http://www.epa.gov/watrhome/you/chap1.html>.

[73]Micro-irrigation system (drip + sprinkler) about 5.7% of total irrigated acreage
Various gravity forms (at 50%) are about 43.9% of total irrigated acreage
Other sprinklers irrigate about 51.2% of total irrigated acreage
United States Department of Agriculture National Agricultural Statistics Department, *2003 Farm & Ranch Irrigation Survey (2002 Census of Agriculture| Volume 3, Special Studies, Part 1)*. Nov 2004. *United States Department of Agriculture National Agricultural Statistics Department*, 28/Oct/2005 <http://www.nass.usda.gov/census/census02/fris/fris03.pdf>.p8.
Table 4. Land Irrigated by Method of Water Distribution: 2003 and 1998

Micro irrigation systems average around 82.5% irrigation efficiency
Gravity irrigation systems average around 50% irrigation efficiency
Other sprinkler average around 70% irrigation efficiency

Michael D. Dukes, *Types and Efficiency of Florida Irrigation Systems*, (Note: Data Used Was from National Sources). Dec 2002. *University of Florida - Agricultural and Biological Engineering Dept*, 28/Oct/2005 <http://www.agen.ufl.edu/~mdukes/publications/Types_and_Efficiency_of_Florida_Irrigation_Systems.pdf>..p8.

So applying the efficiency numbers from the second source to the acreage in the first, we can calculate that current average irrigation efficiency is around 62%. If that average efficiency was upgrade to micro-irrigation levels we would reduce water use for irrigation nationally by an average of one third.

[74]I. Broner, *Irrigation: Tailwater Recovery for Surface Irrigation*. *Crop Series*, 4.709. 1998. *Colorado State University Cooperative Extension*, 17/Sep/2005 <http://www.ext.colostate.edu/pubs/crops/04709.PDF>.

[75]Pacific Northwest Pollution Prevention Resource Center, "Topical Reports -Energy and Water Efficiency for Semiconductor Manufacturing," *Pollution Prevention (P2) Pays - N.C. Division of Pollution Prevention and Environmental Assistance*, Feb 2000, Pacific Northwest Pollution Prevention Resource Center, 17/Sep/2005 <http://www.p2pays.org/ref/04/03271/>.

[76]Hidetoshi Wakamatsu, Akira Mayuzumi, and Norio Tanaka, "Effective Utilization Technology for Ultra Purewater, Chemical Liquids and Waste Materials on Semiconductor Manufacturing Plant,". *OKI Technical Review* 68, no. 188: Special Edition on the Environment Dec 2001, Oki Industry Co. Ltd - Environment Division, 23/May/2004 <http://www.oki.com/en/otr/downloads/otr-188-06.pdf>.pp23 – 27.

[77] Stanford University News Service, *Can Computer Chip Makers Reduce Environmental Impact?* 5/Jun 1996, Stanford University News Service, 4/Jun/2004 < http://www.stanford.edu/dept/news/pr/96/960605chipsenvir.html>.