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WATER-USE-EFFICIENCY IN HOMES and BUILDINGS

Description:

Across the country, a growing population is putting stress on available water supplies. Between 1950 and 2000, the U.S. population nearly doubled. However, in that same period, public demand for water more than tripled. Each American now uses an average of 100 gallons of water each day[1]—enough to fill 1,600 drinking glasses! This increased demand has put additional stress on water supplies and distribution systems, threatening both human health and the environment.

There is a reason why water has become a national priority. A recent government survey showed that at least 36 states are anticipating local, regional, or statewide water shortages by 2013.[2] But, by using water more efficiently, we can help preserve water supplies for future generations, save money, and protect the environment.

The average household spends as much as $500 per year on its water and sewer bill; by making just a few simple changes to use water more efficiently, that house could save about $170 per year.[3] If all U.S. households installed water-efficient appliances, the country would save more than three trillion gallons of water and more than $18 billion dollars per year.[4] Also, when water is used more efficiently, there is a reduced need for costly water supply infrastructure investments and new wastewater treatment facilities.

It takes a considerable amount of energy to deliver and treat the water that is used in homes every day. For example, letting a faucet run for five minutes uses about as much energy as letting a 60-watt light bulb run for 14 hours. American public water supply and treatment facilities consume about 56 billion kilowatt-hours (kWh) per year—enough electricity to power more than five million homes for an entire year.[5]

There are many ways to save water in residential buildings, and all of them are cost-effective over a very short time-horizon, making their implementation an economic home-run almost every time. The Federal Energy Policy Act of 1992 (EPAct 1992) issued performance standards for residential water-efficient fixtures and appliances, which are now federal law. These appliances and fixtures include toilets, faucets, showerheads, clothes washers, and dishwashers. The standards are expressed in tables below.[6]

In addition to federal standards, the U. S. Environmental Protection Agency (EPA) has developed certifications to help consumers identify the most energy- and water-efficient products on the market. These certification labels are WaterSense®

and ENERGY STAR®; WaterSense® products use less water than the standards developed for EPAct 1992. The performance characteristics of fixtures and appliances for WaterSense® and Energy Star® are listed in the tables below.[6]

Environmental Protection Agency
WaterSense

National Efficiency Standards and Specifications for
Residential and Commercial Water-Using Fixtures and Appliances

Fixtures and Appliances	EPAct 1992, EPAct 2005 (or backlog NAECA updates)		WaterSense® or ENERGY STAR®		Consortium for Energy Efficiency	
	Current Standard	Proposed/Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed/Future Specification
Residential Toilets	1.6 gpf[1]		WaterSense 1.28 gpf with at least 350 gram waste removal[2]		No specification	
Residential Bathroom Faucets	2.2 gpm at 60 psi[3]		WaterSense 1.5 gpm at 60 psi (no less than 0.8 gpm at 20 psi)[4]		No specification	
Residential Showerheads	2.5 gpm at 80 psi		No specification		No specification	
Residential Clothes Washers	MEF ≥ 1.26 ft^3/kWh/cycle *No specified water use factor	Proposed to DOE Asst. Sec. jointly by AHAM and efficiency advocates to be effective in 2011 MEF ≥ 1.26 ft^3/kWh/cycle WF ≤ 9.5 gal/cycle/ft^3	ENERGY STAR (DOE) MEF ≥ 1.72 ft^3/kWh/cycle; WF ≤ 8.0 gal/cycle/ft^3	ENERGY STAR (DOE) Effective July 1, 2009: MEF ≥ 1.8 ft^3/kWh/cycle WF ≤ 7.5 gal/cycle/ft^3 Effective January 1, 2011: MEF ≥ 2.0 ft^3/kWh/cycle WF ≤ 6.0 gal/cycle/ft^3	**Tier 1:** MEF ≥ 1.80 ft^3/kWh/cycle; WF ≤ 7.5 gal/cycle/ft^3 **Tier2:** MEF ≥ 2.00 ft^3/kWh/cycle; WF ≤ 6.0 gal/cycle/ft^3 **Tier 3:** MEF ≥ 2.20 ft^3/kWh/cycle; WF ≤ 4.5 gal/cycle/ft^3	

[1]EPAct 1992 standard for toilets applies to both commercial and residential models.
[2]See WaterSense HET specification at http://www.epa.gov/watersense/docs/spec_het508.pdf.
[3] EPAct 1992 standard for faucets applies to both commercial and residential models.
[4]See WaterSense specification for lavatory faucets at http://www.epa.gov/watersense/docs/faucet_spec508.pdf.

DOE: Department of Energy
EPA: Environmental Protection Agency
EPAct 1992: Energy Policy Act of 1992
EPAct 2005: Energy Policy Act of 2005
EF: energy factor
ft^3: cubic feet
gal: gallons
gpm: gallons per minute
gpf: gallons per flush
kWh: kilowatt hour
MEF: modified energy factor
MaP: maximum performance
NAECA: National Appliance Energy conservation Act
psi: pounds per square inch
WF: water factor

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Environmental Protection Agency
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Fixtures and Appliances	EPAct 1992, EPAct 2005 (or backlog NAECA updates)		WaterSense® or ENERGY STAR®		Consortium for Energy Efficiency	
	Current Standard	Proposed/Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed/Future Specification
Residential Dishwashers[5]	*Standard models:* EF ≥ 0.46 cycles/kWh *Compact models:* EF ≥ 0.62 cycles/kWh *No specified water use factor (Energy independence & Security Act of 2007: As of Jan. 1, 2010 *Standard models:* 355 kWh/year WF ≤ 6.5 gallons/cycle *Compact models:* 260 kWh/year WF ≤ 4.5 gallons/cycle)	New standards under development: DOE scheduled final action: March, 2009; Stakeholder meeting held 4/27/2006 Proposed to DOE Asst. Sec. jointly by AHAM and efficiency advocates to be effective in 2010 *Standard models:* 355 kWh/year (.62 EF + 1 watt standby) WF ≤ 6.5 gallons/cycle *Compact models:* 260 kWh/year WF ≤ 4.5 gallons/cycle	ENERGY STAR (DOE) *Standard models:* EF ≥ 0.65 cycles/kWh *Compact models:* EF ≥ 0.88 cycles/kWh *No specified water use factor	Proposed to DOE Asst. Sec. jointly by AHAM & efficiency advocates to be effective in 2009 *Standard models:* 324 kWh/year (0.68 EF + 1 watt standby) WF ≤ 5.8 gallons/cycle *Compact models:* 234 kWh/year WF ≤ 4.0 gallons/cycle Phase Two (Proposed by DOE): July 1, 2011 *Standard models:* 307 kWh/year 5.0 gallons/cycle *Compact models:* 222 kWh/year 3.5 gallons/cycle	*Standard models:* **Tier 1:** EF ≥ 0.65 cycles/kWh; maximum 339 kWh/year **Tier 2:** EF ≥ 0.68 cycles/kWh; maximum 325 kWh/year *Compact models:* **Tier 1:** EF ≥ 0.88 cycles/kWh; maximum 252 kWh/year *No specified water use factor	In December 2006, CEE announced they will consider adding a water factor in future dishwasher specifications

[5] *Standard models:* capacity is greater than or equal to eight place settings and six serving pieces; *Compact models:* capacity is less than eight place settings and six serving pieces

DOE: Department of Energy
EPA: Environmental Protection Agency
EPAct 1992: Energy Policy Act of 1992
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ft^3: cubic feet
gal: gallons
gpm: gallons per minute
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kWh: kilowatt hour
MEF: modified energy factor
MaP: maximum performance
NAECA: National Appliance Energy Conservation Act
psi: pounds per square inch
WF: water factor

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It is important to keep in mind that low-flow fixtures (like showerheads and faucet aerators) do not just save water, but save energy, too, because the less hot water a person uses to wash his hands or shower, the less energy is needed to heat water in the home. It is common for people to install faucet aerators that use as little as 0.5 gallons per minute in the bathroom sink, because most people actually use very little water to brush their teeth and wash their faces. In places like New York City, where water is over $7 per 1,000 gallons, changing from a 2.5 to a 0.5 aerator pays for itself in only 50 minutes of use.

Another easy way to save water includes landscaping your property with native plants, which will not require constant watering. The National Wildlife Federation maintains a Web site containing a list of all plants that are native to New York: http://www.nwf.org/Get-Outside/Outdoor-Activities/Garden-for-Wildlife/Gardening-Tips/Using-Native-Plants.aspx?CFID=16918117&CFTOKEN=d0d062feb45740dd-720202C4-5056-A84B-C36EF1A5FFE32A5D.

More advanced concepts in water-efficiency include the limited reuse of "greywater." Greywater is water that has been used for some purpose and is no longer potable. However, it could be used for other activities; for example, some developers have implemented systems where water that has been used to wash hands is subsequently used to flush toilets or water lawns. A similar idea to recycling greywater is the collection and reuse of rainwater. Instead of letting rainwater get washed away from the gutter to the sidewalk, many buildings contain a cistern to capture the water and store it for use at a later date. The primary use for such water is irrigation, which requires little engineering or effort; but there is also the potential to use rainwater for non-potable applications in a building, such as flushing toilets.

Finally, as was discussed earlier, energy and water use are often inextricably linked. Heating systems in the Northeast tend to be either steam or hydronic. In steam systems, water is heated in a boiler and distributed through pipes to radiators, which, in turn, heat the building. The steam turns into hot water after giving off its heat and returns to the boiler to start the cycle again. Hydronic systems circulate hot water through the pipes rather than turning it into steam first. The New York State Energy Research and Development Authority has studied the water use in steam and hydronically heated buildings, and findings show that hydronic systems use dramatically less water (and energy) than most steam systems. Thus, if there is an opportunity to install a hydronic system rather than a steam system in a building, it should be pursued. In conversions from steam to hydronic, it is important to ensure that the pipes are sealed to avoid water leaks throughout the building. Whatever the configuration of a heating system, the amount of water being used by the system should be regularly checked, because excessive water use can be a good indication that something is wrong with the system. A system that is kept in good working order will extend the life of the equipment, save money on utilities, and save the State's resources.

References:

[1, 2] U. S. Environmental Protection Agency, "Water Efficiency," *WaterSense—an EPA Partnership Program:* http://epa.gov/watersense/our_water/what_you_can_do.html.

[3, 4, 5] U. S. Environmental Protection Agency, "Benefits of Water Efficiency," *WaterSense—an EPA Partnership Program:* http://www.epa.gov/watersense/water_efficiency/benefits_of_water_efficiency.html.

[6] U. S. Environmental Protection Agency, *National Efficiency Standards and Specifications for Residential and Commercial Water-Using Fixtures and Appliances*: http://www.epa.gov/watersense/docs/matrix508.pdf.

Benefits:

For consumers:

- Water- and energy-efficient appliances and features save significant household expenses—making homeownership and rental properties more affordable for greater numbers of householders and allowing greater numbers of individuals to remain living in the community.

- Grants and rebates are available for Energy STAR® and other water-saving appliances.

For the community:

- By reducing household water use, householders not only help reduce the energy required to supply and treat public water supplies but also can help address climate change. For example, according to the U. S. Environmental Protection Agency (*http://water.epa.gov/infrastructure/sustain/waterefficiency.cfm*):
  - If one out of every 100 American homes were retrofitted with water-efficient fixtures, about 100 million kWh of electricity per year would be saved—avoiding 80,000 tons of greenhouse gas emissions. That is equivalent to removing nearly 15,000 automobiles from the road for one year.
  - If one per cent of American homes replaced their older, inefficient toilets with WaterSense®-labeled models, the country would save more than 38 million kWh of electricity—enough to supply one month's electricity for more than 43,000 households.

Impediments or barriers to development or implementation:

- Some efficiency strategies are too advanced for "do-it-yourself" applications and require the skills and knowledge of professionals; for example:
  - The use of greywater is an advanced strategy, requiring engineering and some level of filtration, and should be pursued only after all of the nuts-and-bolts technologies have been implemented.
  - Rainwater collection and use is a much more advanced application and would require some level of filtration and engineering.

- Hydronic heating systems require some design and engineering work and may not be appropriate for every application.

Resource—examples:

- U. S. Environmental Protection Agency, Office of Water (July, 2002), *Cases in Water Conservation: How Efficiency Programs Help Water Utilities Save Water and Avoid Costs* (EPA832-B-02-003). This publication documents the efforts and achievements in strategic water-efficiency programs in 17 municipalities across the country (including New York City), including resources and contact names for further information: http://www.epa.gov/watersense/docs/utilityconservation_508.pdf.

Resource—written and web:

- Portfolio Manager,® a tool developed by the U. S. Environmental Protection Agency, tracks water-use in homes and buildings, across portfolios, over time—which can help owners determine which buildings or fixtures are high-users and how the intensity of their energy- and water-use ebbs and flows over time. Available free online at: http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager.

- United States Energy Policy Act of 1992 (EPAct 1992): http://thomas.loc.gov/cgi-bin/query/z?c102:H.R.776.ENR:.

- U. S. Environmental Protection Agency: http://www.epa.gov/.
  Laws, Regulations, Guidance and Dockets: http://www.epa.gov/lawsregs/.
  Links to resources related to *WaterSense*®:
  http://nlquery.epa.gov/epasearch/epasearch?areaname=&areacontacts=http%3A%2F%2Fwww.epa.gov%2Fepahome%2Fcomments.htm&areasearchurl=&result_template=epafiles_default.xsl&action=filtersearch&filter=&typeofsearch=epa&querytext=WaterSense.

- New York State Energy Research and Development Authority (NYSERDA): http://www.nyserda.ny.gov/.
  Links to resources related to *Energy Star:*
  http://www.nyserda.ny.gov/Programs/Residential/Energy-Efficient-and-ENERGY-STAR-Products.