DOE Supplemental Guidance to the Instructions for Implementing Executive Order 13423 "Strengthening Federal Environmental, Energy, and Transportation Management"

Establishing Baseline and Meeting Water Conservation Goals of Executive Order 13423

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FEMP

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Establishing Baseline and Meeting Water Conservation Goals of Executive Order 13423

Purpose

This document provides clarification and guidance to achieve the water reduction goals of section 2(c) of Executive Order (EO) 13423, *Strengthening Federal Environmental, Energy, and Transportation Management* (72 FR 3919; January 29, 2007) and the *Instructions for Implementing Executive Order 13423*, dated March 29, 2007. Beginning in 2008, Federal agencies must reduce water consumption intensity through life-cycle cost-effective measures, relative to the baseline of the agency's water consumption in fiscal year 2007 by 2 percent annually through the end of FY 2015 or 16 percent by the end of FY 2015.

This guidance was developed to assist in the interpretation of, and ultimate compliance with, EO 13423. Specifically, three key elements of compliance were identified and presented: baseline development, efficiency opportunity identification/ implementation, and necessary reporting. For each key area, this document provides EO 13423 interpretation, suggests a path forward, and provides resources for additional information.

In addition to EO 13423, as discussed further below, the accompanying implementing instructions advise agencies to conduct water audits of at least 10 percent of facility square footage annually and conduct new audits at least every 10 years, thereafter. Also, where applicable, agencies should purchase water efficient products and services, including WaterSense [SM] labeled products, and use contractors who are certified through a WaterSense labeled program.[1]

Introduction

A historical review provides the context supporting EO 13423. In 1999, EO 13123, *Greening the Government through Efficient Energy Management*, was established and stated in part that, *"through life-cycle cost-effective measures, agencies shall reduce water consumption and associated energy use in their facilities to reach the goals set under section 503(f) of this order."* 64 FR 30851, 30852 (June 18, 1999). Sections 502 and 503 directed the Department of Energy to develop guidance for the calculation of a

[1] EPA's WaterSense program is a voluntary public-private partnership that identifies and promotes high-performance products and programs that help preserve the nation's water supply. More information can be found at www.epa.gov/watersense.

water consumption baseline, and establish water conservation goals for Federal agencies. EO 13123 followed the Energy Policy Act of 1992, which required Federal facilities to install water conservation measures with a payback of less than 10 years. (42 U.S.C. 8253(b)(1))

It should be noted that the requirements under EO 13123 generally were superseded by EO 13423. To the extent that it is inconsistent with EO 13423 and the associated implementing instructions, guidance promulgated under EO 13123 on the development of Water Management Plans and the implementation of Best Management Practices is superseded by this guidance. However, agencies are encouraged to use these existing tools to the extent permissible in achieving the goals of EO 13423.

With over 500,000 facilities in the Federal building stock, the intent of this guidance is to provide information to agencies tasked with meeting the water reduction goal of EO 13423. Considering the vast array of water sources, cost, and end-use consumption, the application of conservation strategies will likely employ a diverse set of approaches.

Executive Order Interpretation

As presented in section 2(c) of EO 13423, each agency is directed: ***Beginning in FY 2008, [to] reduce [facility] water consumption intensity, relative to the baseline of the agency's water consumption in FY 2007, through life-cycle cost-effective measures by 2 percent annually through the end of fiscal year 2015 or 16 percent by the end of FY 2015.***

Meeting this Executive Order requires the following steps:

1. ***Baseline development*** – calculate a baseline of FY 2007 water use intensity, defined as gallons per gross square foot per year. All future reduction goals will be measured relative to this baseline.

2. ***Reduction of water use intensity*** - identify and implement life-cycle cost-effective water savings measures to achieve in agency facilities at minimum 2 percent annual reduction or 16 percent overall reduction of water use intensity by the end of FY 2015.

3. ***Reporting*** – under section 3(g) of EO 13423, agencies are required to: *provide reports on agency implementation of this order to the Chairman of the Council on such schedule and in such format as the Chairman of the Council may require.* Existing reporting procedures in place as of January 24, 2007 shall continue until and unless superseded pursuant to sections 3(g) and 4 of the Executive Order. This includes statutorily required reporting, such as annual reporting to DOE on facility and fleet energy use, which shall continue in accordance with the established reporting deadlines for those reports. DOE will amend its energy data

report to include guidance on accurate reporting of water consumption and savings data, beginning with the 2008 report.

To assist in implementation of the Executive Order, and for the purpose of implementing this guidance, the following definitions apply:

Water use – is defined as all water used at Federal facilities that is obtained from public water systems or from natural freshwater sources such as lakes, streams, and aquifers, where the water is classified or permitted for human consumption. Some examples include potable water used for drinking, bathing, toilet flushing, laundry, cleaning/food services, watering of landscaping, irrigation, and process applications such as cooling towers, boilers, and fire suppression systems.

Gross square footage or square footage - To avoid challenges associated with reporting two separate square footage values (for energy and for water), the square footage reported for a building or other facility subject to both the energy and water requirements will rely on the value reported for the energy use of that facility. While the resulting water use intensity will not be usable to make comparisons with other agencies or published standards, the results can be used to assess the progress being made to reduce water use within each agency.

Facility - means any building, installation, structure, land, and other property owned or operated by, or constructed or manufactured and leased to, the Federal Government, as well as any fixture. This term includes a group of facilities at a single or multiple location(s) managed as an integrated operation, as well as government-owned contractor-operated facilities. Each agency's total facility square footage for water use will be the same as the value reported for total facility square footage for energy use. However, the square footage used to calculate progress toward established energy use and water use reduction goals will differ if certain facilities are exempted from one goal, but not both. Water consumption for facilities that are occupied by multiple agencies will be reported by the agency that reports the energy consumption.

Exemptions – Section 8(d) of EO 13423 provides for exemptions to the water conservation requirements. However, granting of exemptions is discouraged in favor of focusing on the identification of opportunities based on the life-cycle economics of the situation.

Exemptions will be handled on a case-by-case basis. The head of a Federal agency may request an exemption for specific facilities or processes using the procedures outlined in section 8 of EO 13423. The request should document efforts already taken to reduce water consumption and/or to substitute non-potable water for potable water uses for the specified facilities or processes. All cost-effective measures should have been considered and implemented and appropriately documented as part of the request. The request for an exemption

must be renewed annually. A copy of current exemption is to be submitted with annual data reports. Regardless of the approval of exemptions, the reporting of total facility square footage will be the same as reported for energy use.

Agencies are encouraged to focus on reducing water consumption for the agency as a whole, and concentrate their efforts on the facilities with the most potential. In accordance with that philosophy, agencies should seriously consider only submitting exemption requests at the agency level, and only after all cost effective water projects have been implemented.

Water used at certain types of facilities, i.e., non-Federal buildings for which the utility costs are not paid by the reporting agency, should not be included in water reporting. Examples of these facilities types are:

> ***Leased facilities*** – facilities with fully-serviced leases, where the landlord is responsible for paying all water bills. Agencies have little control over how the building is operated and maintained and cannot implement water conservation measures.
>
> ***Privately owned facilities*** – buildings/facilities that are co-located on Federal lands but privately owned (e.g., fast food restaurants, credit union buildings, and privatized family housing). These are not considered part of the Federal building inventory.

Baseline Development

Executive Order 13423 requires all Federal agency heads to develop a water-use baseline based on FY 2007 water consumption. All potable water use in covered facilities should be reported, whether used for human consumption, building process, power plant or building cooling, landscape watering, irrigation, or industrial uses.

Metered Facilities:
Consumption for all Federal facilities with a water meter is to be included in the total water use for the baseline period. Water consumption will include all uses of potable water. Each agency will develop a water use intensity (WUI) number, which is defined as annual potable water use divided by total gross square footage of facility space[2]. To avoid adding additional reporting requirements, there is no provision for reporting square footage of irrigated turf or landscape. Potable water used for landscape irrigation is to be reported in the agency total water use, but the amount of turf or landscape area is not included in the gross square footage reporting.

[2] Facility space for this calculation will include both goal subject and goal exempt square footage since a goal exempt facility may still have reportable water consumption.

Unmetered Facilities:

Some Federal facilities may not have a utility water meter. Because the EO 13423 requires agencies to report potable water use, agencies that have sites without metered potable water use must estimate water consumption. Agencies are encouraged to give auditing priority to unmetered facilities, and support the incorporation of metering to the extent that it enables both baseline development and annual reports to be current and accurate indicators of the agencies progress toward the water use reduction goal.

It is important to document the assumptions and estimating techniques used so that they can be repeated in coming years to measure progress towards reduction goals. Of equal importance is documenting the adjustment to baseline consumption data, once efforts are implemented to account for unmetered facilities either through metering or estimating techniques. All baseline adjustments must be documented and submitted with annual data reports.

Federal facilities that produce their own potable water from wells are encouraged to install water production meters to meter the amount of water produced. In the absence of water meters, well production can be estimated using pump flow rates at the given well depth multiplied by known runtime. Pump flow rate data is typically specified at design; runtime can be monitored easily and inexpensively for representative intervals and then applied to annual calculations. Agencies producing their own water are requested to report water consumption data consistent with their own respective measuring methods (i.e., the use of daily logs, metered data, or flow estimates). The intent is to account for and record what the agency is currently using relative to its established baseline consumption.

Efficiency Opportunity Identification

In addition to development of the baseline, the implementing instructions advise that all agencies should conduct water audits for at least 10 percent of agency square footage annually. These audits should be done in concert with the required energy audits, and should include associated exterior potable water use, if appropriate. These audits can be invaluable in identifying potential water efficiency opportunities. In this regard, the annual audits should be designed so that at the end of a ten-year period the entire agency square footage will have been audited and documented. Assuming 100% of agency facilities have been audited over a 10-year period; re-audits should take place at least every 10 years thereafter (10% of agency square footage per year).

In the Federal sector, approximately half of the potable water consumed is used for domestic purposes, with the remaining balance attributed to engineered related uses[3].

[3] *'Engineered Related Uses'* are technologies considered to be those most likely requiring a higher capital investment, and some level of engineering/design support to implement. These include, but are not limited to, boiler systems, steam and condensate systems, cooling tower and chiller systems, irrigation systems,

Based on recent data (PNNL, 2005), there is a significant opportunity to capture and realize savings from implementation of cost-effective water conservation measures. Considerable effort has been put into establishing estimates of water use reduction based on "off the shelf" technology. While this does not account for engineered related uses, estimates suggest that a reduction of 35 to 50 billion gallons/year is achievable.

Each agency is encouraged to prioritize the installation of water conservation measures based on their own practices and applications. This is a natural extension of Water Management Plans (WMP), recommended by DOE under Executive Order 13123. These WMPs provide a more formal framework, enabling end-users to prioritize implementation strategies based on the following:

Collection of background information*:* Establish number of facilities, current technologies deployed, historical use (process vs. non-process), projected use (expansion-contraction), applicability (metered potable, unmetered), and information regarding performance contracts in place, water rates, and water sources.

Categorize water type and usage*:* Determine whether water is potable or non-potable[4]. Identify ultimate use of the water (domestic water usage such as cooking & drinking, HVAC, process or special use, irrigation, or etc. Determine if the water usage is metered. Find out whether the water is supplied by another entity or if it is produced onsite.

Identify relevant best management practices and efficiency opportunities: Best Management Practices (BMPs) were developed by the Department of Energy Federal Energy Management Program (FEMP) in response to the requirements set forth in Executive Order 13123, which required Federal agencies to reduce water use through cost-effective water efficiency improvements. These BMPs are the foundation of a specific installation or agency-wide water management plan (WMP). The Environmental Protections Agency's WaterSense Office is in the process of updating the BMPs for FEMP to account for recent changes in technology and in water usage patterns. Information on development of a WMP and currently available BMPs can be found at:

http://www1.eere.energy.gov/femp/water_fedrequire.html

Information regarding common "off-the-shelf" water efficiency technologies and common engineered solution water efficiency opportunities is provided in Appendix A. Background information on water conservation/efficiency, status of water resource, and importance in the Federal sector can be found at the following:

http://www1.eere.energy.gov/femp/water

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single-pass cooling systems, water and waste water treatment plants, and comprehensive leak detection strategies.

[4] Only potable water is reportable.

http://www1.eere.energy.gov/femp/water/water_basics.html

Establish life-cycle cost/cost to implement: Per the Instructions for Implementing Executive Order EO 13423, life-cycle cost-effective measures should be implemented. If more than one measure is identified for the same process or use, the measure reporting the lowest life-cycle cost (highest net present value) should be implemented. Additional resources on life-cycle cost calculations can be found at:

http://www1.eere.energy.gov/femp/procurement/eep_eccalculators.html

Implementation: Once identified and found to be life-cycle cost-effective, project implementation should begin. Careful attention should be paid to actual product/system selection, installation, and cost during this phase.

Measurement and verification: Quantifying the benefits of project implementation should be part of the overall plan. Facility managers should insist on permanently-installed water meters for all major water uses, retrofit projects, and tenant organizations. Current measurement and verification guidance for water projects can be found at:

http://www.eere.energy.gov/femp/pdfs/26265_secvii.pdf

Assessment and Prioritization of Opportunities

To provide a more descriptive approach to the water conservation goal, a distinction in efficiency opportunities needs to be made. For the purposes of this guidance document, '*off-the-shelf*' technologies are considered to be those that use domestic, potable water, and are easily purchased and installed. These include but are not limited to toilets, urinals, showerheads, faucets, and non-industrial clothes washers.

A key tool in making '*off-the-shelf*' decisions and purchases is the Environmental Protection Agency's WaterSense program. This program is a voluntary public-private partnership that identifies and promotes high-performance products and programs that help preserve the nation's water supply. More information on the WaterSense program can be found at:

www.epa.gov/watersense

'Engineered Related Use' are considered to be those technologies likely requiring a higher capital investment, and some level of engineering/design support to implement. While these technologies may be more difficult to implement, these proven solutions can produce a comparable amount of savings, and should be considered.

Implementation Strategy

Because the execution of any strategy will most likely be a combination of 'soft' practices such as public information and education programs, and 'hard' practices such, as replacing high volume showerheads with low volume fixtures, implementation should be site-specific in order to account for variances in water source, cost (incoming and disposal), distribution and allocation, the existing infrastructure, and current practices. Reviewing water reduction opportunities in these terms will enable end users to tailor their own respective programs around attainable goals.

Methods of Funding

Water projects may be implemented using any of the funding mechanisms currently used to fund energy projects, as appropriate. Project funding comes in many forms, such as appropriations, energy savings performance contract (ESPC) and Utility Energy Service Contract (UESCs) programs; ratepayer incentive programs such as rebates from public benefit funds or utilities; and the retention of energy and water cost savings.

Appropriated Funding

Appropriated funds can come in several different forms. Sometimes large projects are funded directly by line-item projects. An installation is sometimes able to implement smaller projects using their operating and maintenance budget (e.g., O&M dollars), which come from appropriations. In addition, special programs are available to provide capital dollars specifically for energy and water projects. One example is the Energy Conservation Investment Program (ECIP), which is available to the Department of Defense. However, appropriated funds may be difficult to secure, and difficult to secure consistently, for such projects.

Energy Savings Performance Contract and Utility Energy Service Contract Programs

These programs enable agencies to finance projects through private sector firms that design and implement projects and guarantee savings to the government. Under these programs, a private sector firm or utility makes the upfront capital investments and is paid through realized energy and water savings.

Energy Savings Performance Contract (ESPC)

An ESPC permits energy service companies (ESCOs) to assume the capital costs of installing, operating and maintaining energy and water conservation measures and equipment. In the ESPC process, the ESCO guarantees a fixed amount of energy cost savings throughout the term of the contract (up to 25 years) and is paid directly from the cost savings generated by the project. An ESPC must include methods for establishing a baseline water use and cost and for measuring and verifying the value of the savings for each year.

Any Federal site may enter into an ESPC with an ESCO of their choice. FEMP has also developed a Super-ESPC concept that streamlines the contracting process by developing indefinite demand, indefinite quantity (IDIQ) contracts with several ESCOs, under which task orders can be awarded in a particular region of the country. Originally, water projects could be funded under ESPCs only if there was also an energy savings component. However, the current definition of "energy savings" for the purpose of an ESPC, includes a reduction in the "cost of energy, water, or wastewater treatment". (42 U.S.C. 8287(c)(2))

http://www1.eere.energy.gov/femp/financing/superespcs.html

Utility Energy Service Contract (UESC)

Under an UESC, the servicing utility for an installation provides financing and expertise to implement energy and water projects. The utility is repaid over the contract term from the cost savings generated by the energy efficiency measures (i.e., retrofits). In this arrangement, the net cost to the Federal agency is minimal, and the agency saves time and resources by using the one-stop shopping provided by the utility. UESC projects can include services such as energy audits, project design and installation, construction management, commissioning, measurement and verification, and operations and maintenance. Not all utilities will enter into a UESC arrangement, so the servicing utilities should be consulted prior to considering this option. An UESC is a slightly different structure than an ESPC contract because of rules about established-source purchases and other requirements.

http://www1.eere.energy.gov/femp/financing/uescs.html

Utility Ratepayer Incentive Programs

Some water utilities provide technical assistance to their customers to implement both water conservation and water reclamation projects. Some of the programs include rebates for implementation of water efficient equipment. The most comprehensive programs are typically associated with utilities located in areas of the country that are already experiencing reduce water supplies, such as the southwest. Austin Water is an example of a more comprehensive program that incorporates aspects of specific regulations regarding water use equipment, available technical assistance and rebates, and providing outreach materials to its customers. Information regarding the Austin Water program can be found at:

http://www.ci.austin.tx.us/water/default.htm

Agencies are encouraged to contact their respective water utility to determine what resources are available to them. In addition, some states have agencies that also provide technical information and assistance related to water conservation and reclamation projects (see information provided in the section on "Resource Available from Non-Federal Sources" for some examples.)

Reporting Progress Towards Reduction Goals

In determining progress toward reduction goals, it is necessary to determine water use intensity, as was done for the baseline period, and calculate percent change. Being consistent in the methods used to determine water use intensity during the baseline and in the out years is important.

Facilities with metered or estimated use: Facilities that have direct metered water use, or have estimated water use in one or more facilities should report their annual water use using the same method used during for the baseline period.

Sites with newly installed water meter: In the event a facility water meter is installed after the baseline was determined by using estimating techniques, the estimating technique in the current year should be repeated. Then compare the current year estimated value with the actual metered data. If the two values are significantly different, it makes sense to revise the baseline value once new, reliable data are available. The use of actual verifiable (metered) data should always supersede estimates.

FEMP will be revising instructions regarding submittal of annual report information by agencies that will include information regarding method and timing of reporting of the water consumption baseline data and how baseline data can be adjusted based significant new information obtained from additional metered data collected by an agency. Specific instructions regarding the annual submittal of requests for exemptions by agency heads should be included in those instructions. FEMP will work with the appropriate agencies to determine ways to streamline, consolidate, and simplify reporting requirements and metrics relevant to EO 13423.

References

Executive Order 13123: *Greening the Government Through Efficient Energy Management*, Federal Register June 1999.

Executive Order 13423: *Strengthening Federal Environmental, Energy and Transportation Management,* Federal Register January 2007.

Instructions For Implementing Executive Order 13423: *Strengthening Federal Environmental, Energy, and Transportation Management,* March 29, 2007.

The Energy Policy Act of 1992 (EPACT), Public Law 102-486.

PNNL 2005 *Update of Market Assessment for Capturing Water Conservation Opportunities in the Federal Sector*, PNNL, 2005.

FEMP Resources Available

http://www1.eere.energy.gov/femp/index.html

The United States Department of Energy Federal Energy Management Program's (DOE-FEMP's) Water Efficiency Web site describes water-efficiency basics, answers frequently asked questions about water-efficiency, outlines Federal requirements for improvements at Federal facilities, lists the 10 Best Management Practices required for partial adoption at Federal facilities under E.O. 13123, and provides guidance for establishing water-use baselines and setting improvement goals.

DOE FEMP's WATERGY software tool is a spreadsheet model for Federal facilities managers to use to analyze the potential for water savings and associated energy savings at their facilities.

DOE FEMP's *Federal Technology Alert: Domestic Water Conservation Technologies* outlines the 10 water Best Management Practices that agencies must partially adopt under E.O. 13123; major areas of water use at Federal facilities (including housing, hospitals, and office buildings); and hardware-based water- and energy-saving mechanisms.

DOE FEMP's *Federal Technology Focus: Saving Energy, Water, and Money with Efficient Water Treatment Technologies* outlines technologies for water purification through reverse osmosis, high efficiency reverse osmosis, and reverse osmosis/electro-deionization; and includes a case study.

DOE FEMP's O & M Best Practices: A Guide to Achieving Operational Efficiency describes recommended best practices.

DOE FEMP's *Greening Federal Facilities* (2001) includes a section on water and wastewater, providing guidance on water management and demand side savings opportunities.

DOE FEMP's water-related case studies:

- "Heating Water with Solar Energy Costs Less at the Phoenix Federal Correctional Institution"
- SAVEnergy Walk-thru Audit at Portland, Oregon Veterans Hospital
- Technical Assistance at Biscayne National Park
- Metering at Sandia National Laboratories (New Mexico)
- Water efficiency showcase at the Denver Federal Center
- Irrigation improvements at The Pentagon.

Implementing Water Conservation Goals at Federal Facilities – Lessons Learned (2001) is a conference paper prepared by staff at the National Renewable Energy Laboratory.

Resources Available from Other Federal Agencies

The United States Department of Defense's (DOD) *Unified Facilities Criteria (UFC): Water Conservation Operation and Maintenance* provides numerous methods to increase water efficiency and details the requirements of EO 12902 as it relates to water conservation within the DOD. The handbook also includes, in its appendices, procedures for submitting water conservation projects for central funding programs.

EPA's WaterSense program is a new voluntary public/private partnership to promote water efficiency and enhance the market for water-efficient products, services and practices. The program develops specifications for high efficiency, high performing products. All products are certified to the criteria by an independent, third-party organization. Lists of products and services meeting WaterSense criteria are available on the web site. www.epa.gov/watersense/

The Energy Star Program is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy designed to help save money and protect the environment through energy-efficient products and practices. Many Energy Star products save both water and energy. The program also has a Building Portfolio Manager that helps building managers track and monitor their building energy and water use. www.energystar.gov

EPA's *Water Conservation Plan Guidelines* guidebook is intended to assist water utilities in designing and implementing water conservation plans. It includes an overview of the benefits of water conservation; an overview of the conservation planning process; and basic, intermediate, and advanced guidelines for designing and implementing water conservation plans.

EPA also has published *Achieving Environmental Excellence: An Environmental Management Systems Handbook for Wastewater Utilities (2004),* and provides an overview of energy and environmental processes as related to ISO 14001 – Environmental Management Systems.

The United States General Services Administration (GSA) *Water Management Guide* is written for GSA facility managers and provides guidance on developing water management plans, including drought management plans. It includes overviews of available technologies (plumbing, HVAC, and landscaping/irrigation), wastewater recycling, and financing options. The water management techniques discussed in the document focus on 1) reducing losses, 2) reducing water use, and 3) water reuse.

The Laboratories for the 21st Century Program is a voluntary partnership program dedicated to improving the environmental performance of laboratories. The program has a series of Best Practices Guides including: "Water Efficiency Guide for Laboratories". www.labs21century.gov

The United States Air Force's *Water Conservation Guidebook* is intended to assist Air Force installations in meeting the new water conservation requirements of Executive Order 13123.

Resources Available from Non-Federal Resources

Water and Wastewater Industries: Characteristics and Energy Management Opportunities (1996) from the Electric Power Research Institute (EPRI) covers opportunities in water and wastewater, and is targeted to electric utilities and water/wastewater utilities. EPRI reports are typically very expensive to obtain, however. Other relevant EPRI reports include *Quality Energy Efficiency Retrofits for Water Systems* (1997) and *Quality Energy Efficiency Retrofits for Wastewater Systems* (1998).

The Watergy Web site: a project of the Alliance to Save Energy funded by the United States Agency for International Development, is intended for water utilities and identifies the link between water and energy consumption; outlines various styles of management and the associated costs and benefits of each; details numerous management and supply- and demand-side efficiency activities; and provides tip sheets and resource lists for efficiency improvement.
http://www.ase.org/section/program/watergy/

The State New Mexico Office of the State Engineer's *Water Conservation Guide for Commercial, Institutional, and Industrial Users* outlines typical water use profiles by industrial categories; methods for creating a water conservation program; guidelines for water conservation in domestic/indoor settings, landscaping, and heating/cooling-systems; and case studies.

The Iowa Association of Municipal Utilities published *How to Save Energy and Money in Your Water and Wastewater Systems* (1998) and *Water Wise: Water Efficiency Planning and Capacity Development for Water and Wastewater Utilities* (2002).

The Energy Center of Wisconsin and the Wisconsin Focus on Energy have publications, such as *Energy-Saving Opportunities for Wastewater Facilities* (2003).

American Water Works Association (AWWA) provides water conservation and efficiency information, resources, and training related to water treatment facilities. Relevant publications include *Best Practices for Energy Management* (2003) and *Applying Worldwide BMPs in Water Loss Control*, an article in the August 2003 issue of the AWWA Journal.

Water Audits and Leak Detection, American Water Works Association, *Manual of Supply Practices*. AWWA Number M36

A 'drip' calculator can be found at the American Water Works Association (AWWA); www. waterwiser.org

Preventing Water Loss in Water Distribution Systems: Money Saving Leak Detection Programs. US Army Corp of Engineers Construction Engineering Research Laboratory, Technical Report Number N-86/05

Federal Water Management Practices and Opportunities May 2007. Prepared for the U.S. Department of Energy, Federal Energy Management Program by the Alliance to Save Energy.

The Water Environment Federation (WEF) provides resources and training related to wastewater treatment facilities, such as *Energy Conservation in Wastewater Treatment Facilities* (1997).

NRDC's *Energy Down the Drain: The Hidden Cost of California's Water Supply* quantifies the electrical savings potential of water conservation in the western U.S.

The Irrigation Association provides water conservation and efficiency information, resources, and training.

Roadside Use of Native Plants; Federal Highway Administration; or environment@fhwa.dot.gov

USDA's Natural Resources Conservation Service Guide on Native Plant Species and Water Conservation:
http://www.mt.nrcs.usda.gov/technical/ecs/plants/xeriscp/water.html

The Whole Building Design Guide's Best Management Practices for Water Conservation:
http://www.wbdg.org/design/conserve_water.php

"Water Conservation on Golf Courses" by J. T. Snow at:
http://www.usga.org/turf/articles/environment/water/water_conservation.html

Appendix A - Water Efficiency Opportunities

Common "Off-the-Shelf" Water Efficiency Technologies

Technology Category	Type Detail	Federal Application (building type)	Water Use			Savings Potential	Comments
			Traditional	Existing Standard	High Efficiency		
Faucets	Lavatory: Private Use	Residential housing, barracks, and other dwelling units, including hotel guest rooms and hospital rooms	3 gpm	2.2 gpm at 60 psi	1.5 gpm at 60 psi – Look for WaterSense label	1.5 gpm	Simple and very cost-effective retrofit. Note that hospitals should not use aerating faucets; use laminar flow devices instead. Entrained air can trap bacteria and germs.
	Lavatory: Public Use	Public buildings, transportation facilities, schools and other educational facilities, office buildings, food service facilities, mercantile facilities, and other facilities that are not intended for private use.	3 gpm	2.2 gpm at 60 psi	0.5 gpm at 60 psi per ASME A112.18.1	2.5 gpm	Current ASME standard is highly efficient and incorporated currently in most plumbing codes, but not regularly enforced. Faucet may be controlled manually or by sensor
	Lavatory: Metering Faucet may be actuated manually or by sensor	High use applications		0.25 gallons per cycle			A faucet that after actuation dispenses water of a predetermined volume for a predetermined period of time. The volume or cycle duration can be fixed or adjustable. Faucet may be controlled manually or by sensor
	Kitchen and other applications	Kitchens, pantries, food service facilities, other non-lavatory applications	3-5 gpm	2.2 gpm	none	2.8-1.5 gpm	Simple and very cost-effective retrofit.

Technology Category	Type Detail	Federal Application (building type)	Water Use			Savings Potential	Comments
			Traditional	Existing Standard	High Efficiency		
Showerhead	Wall mount, Handheld	Barracks, offices	3.5-5 gpm	2.5gpm at 80 psi	2.0 gpm at 80 psi. WaterSense specification under development	~12 gal/shower[5]	Showerhead flow rate decreases over time due to scale build-up. Flow rate at replacement may be 75% of manufacturer rated flow.
Toilets	Gravity Flush Tank	Residential housing	Pre1980: 5 gal/flush 1980-94: 3.5 gal/flush	1.6 gal/flush	1.28 gal/flush with at least 350 gram waste removal. Look for WaterSense label	2.2 - 3.7 gal/flush	New models are engineered for effective flushing.
	Pressure Assist Tank	Residential housing, Commercial facilities and barracks	Pre1980: 5 gal/flush 1980-94: 3.5 gal/flush	1.6 gal/flush	1.28 gal/flush with at least 350 gram waste removal. Look for WaterSense label	2.2 - 3.7 gal/flush	Supplemental supply-line pressure used to assist in flushing.
	Flush Valve	Commercial facilities and barracks	Pre1980: 5 gal/flush 1980-94: 3.5 gal/flush	1.6 gal/flush	1.28 gal/flush (Currently under review by WaterSense)	2.2 - 3.7 gal/flush	Flush valve and bowl should be matched for effective flush action.
Urinals	Standard Flush	Commercial facilities and barracks	1.5 – 3 gal/flush	1.0 gal/flush	0.5 gal/flush (Currently under review by WaterSense)	2.5-1 gal/flush	Proven technology in widespread use. Highly efficient (<0.25 gal/flush) products are emerging in market.
	No water	Commercial facilities; remote application with limited water and high use	1.5 – 3 gal/flush	1.0 gal/flush	0.0 gal/flush (Currently under review by WaterSense)	3-1.5 gal/flush	Some maintenance and user acceptability issues but increasing in use in Federal sector.

[5] Based on the average duration of a shower is 8 minutes.

Technology Category	Type Detail	Federal Application (building type)	Water Use			Savings Potential	Comments
			Traditional	Existing Standard	High Efficiency		
Clothes Washers	Standard Vertical Axis or Front Loading	Barracks, lodging, recreation facilities	35-55 gal/load	9.5 gal/ft3 Approx. 33 gallons per load or less[6]	8.0gal/ft3 Approx. 28 gal/load or less	7-27 gal/load	Big water & energy savings from high number of loads/day offsets increased first cost. Front and top loaders available.
Commercial Dishwashers	Under Counter	Designed to be installed under food preparation workspaces.	1-1.8 gal/rack	No Standard	1.0 gal/rack	Up to 0.8 gal/rack	Machines with an overall height of less than 36-inches; rack of dishes remains stationary within the machine during sequential wash and rinse sprays. High temp machines are most water efficient.
	Stationary Single Tank Door	Commercial kitchen or cafeteria operations	1.1-2.2 gal/rack	No Standard	0.95 gal/rack	Up to 1.2 gal/rack	Includes machines commonly referred to as pot, pan and utensil washers. Also applies to machines in which the rack revolves on an axis during the wash and rinse cycles. High temp machines are most water efficient.
	Single Tank Conveyor	Commercial kitchen or cafeteria operations	0.7-1.4 gal/rack	No Standard	0.7 gal/rack	Up to 0.7 gal/rack	A single tank conveyor machine has a tank for wash water followed by a final sanitizing rinse and does not have a pumped rinse tank.
	Multiple Tank Conveyor	Commercial kitchen or cafeteria operations	0.54-1.12 gal/rack	No Standard	0.54 gal/rack	Up to 0.58 gal/rack	Machines with one or more tanks for wash water and one or more tanks for pumped rinse water, followed by a final sanitizing rinse.

[6] Based on a capacity of 3.5 cubic feet

Technology Category	Type Detail	Federal Application (building type)	Water Use			Savings Potential	Comments
			Traditional	Existing Standard	High Efficiency		
Commercial Ice Makers	Ice-making head and remote condensing units	Operations requiring larger volume of ice.	Water cooled units can use 150 gal/100 lbs. of ice	No Standard	Air cooled, 25 gal/100 lbs. of ice	125 gal/100 lbs. of ice	Typically larger volume applications where ice-making head and storage bin are separate or ice-making head and condenser units are separate.
	Self-Contained	Most common configuration for low volume applications.	Water cooled units can use 150 gal/100 lbs. of ice	No Standard	Air cooled, 30 gal/100 lbs. of ice	120 gal/100 lbs. of ice	Free standing units where ice-making unit and storage compartment are housed together in a single cabinet.
Pre-rinse Spray Valves	Handheld hose-mounted dish sprayers	Commercial kitchen or cafeteria operations	2-5 gpm	1.6 gpm at 60psi		3.4-0.4 gpm	
Commercial Steam Cookers	Compartment Steamers	Commercial kitchen or cafeteria operations	25-35 gal/hr	No Standard	ENERGYSTAR: Qualified cookers average 2 gal/hr[7]	Up to 33 gal/hr	

[7] http://www.energystar.gov/index.cfm?c=steamcookers.pr_steamcookers

Boilers and Steam Systems

Large Federal facilities often use boilers and steam systems such as central plants, hospitals, large office buildings, barracks, research and development facilities, and industrial and process plants. The amount of water that is consumed by the system depends on the size and water quality, and whether a condensate return is installed and maintained properly. The following bullets briefly describe the techniques that can be used to save water in boilers and steam systems.

- ✓ Proper maintenance: Routinely inspect and maintain steam traps, steam lines, and condensate pumps.
- ✓ Leak detection and repair: Routinely inspect for leaks in condensate return line and steam lines.
- ✓ Condensate return: Properly maintain condensate return, which recycles condensate for reuse in the system thus reducing water and chemical consumption and cost.
- ✓ Blow-down: Minimize blow-down by maintaining adequate water quality through routine inspection and maintenance of boiler water and fire tubes (reducing scale build up), continuous monitoring and skimming of the blow-down, and automatic chemical treatment to control water quality of makeup water.
- ✓ Steam tracers: Shut off steam tracers in the summer. (Steam tracers are used for freeze protection in the winter.)
- ✓ Boiler efficiency and size: Replace boilers that are inefficient or over-sized to reduce water requirements.

Efficient Irrigation

Many Federal facilities have irrigated landscape. Office buildings and hospitals usually have peripheral turf or landscaped beds and military bases commonly have recreation fields and golf courses. These irrigated areas are often sources of large water consumption and are prime targets for efficiency measures. The following list includes typical technologies and techniques that can help to significantly decrease water irrigation consumption; this is commonly undertaken through the practice known as Xeriscaping™. This list does not apply to activities related to fire fighting and only partially apply to agricultural irrigation.

- ✓ The seven principles of Xeriscaping™:
    1. Appropriate design: Use a design that considers soil types and drainage, limits turf area, etc., so that landscaping requires limited irrigation.
    2. Soil improvements: Apply appropriate nutrients to soil to help maintain healthy plants so that minimum water is required.
    3. Reduced turf area: Limit turf to areas for recreation purposes only.

4. Mulching beds: Mulch reduces moisture evaporation off surface of beds and controls weed growth.
5. Efficient irrigation: (also see retrofit options below)

    - Early morning or late evening watering reduces evaporation.
    - Automatic irrigation controls.
    - Appropriate watering schedule to fit plant need and climate
    - Deep watering, less often.
    - Soil moisture sensor (tensiometer) or rain sensor connected to controls to avoid over-watering.

6. Climate-appropriate plants: Native, climate-adapted and other low-water-demand plants that are specifically geared for the particular region reduce both water requirements and maintenance.
7. Maintenance:
    - Proper maintenance and adjustments of sprinkler heads ensures appropriate watering.
    - Routine inspection of irrigation system for leaks and broken heads.
    - Maintain weeds, fertilize properly, and prune as recommended.

✓ Efficient Irrigation Retrofit Options:

- Low-volume drip system: Applies water at a constant rate directly to the root zone of the plant, eliminating runoff and over spray and limiting evaporation
- Sub-surface drip system: Delivers water to root zone of the plant through underground piping, eliminating runoff, over spray, evaporation and reducing maintenance requirements.
- Reuse system: Reuses water from other applications, such as cooling tower bleed-off or other reclaimed water, to irrigate recreational fields or golf courses. (For example, Ft. Carson Army Base uses treated water from the wastewater treatment plant to irrigate the base's golf course, while Peterson AFB uses water captured in retention ponds for the same purpose)

Ozonated Laundering

Ozone acts as biocide destroying bacteria by rupturing cell membranes. In this way, ozonated laundering systems act as a bleaching agent that disinfects fabric. Ozonated laundering systems are most appropriate for applications where laundry does not get overly soiled but where disinfection is an important feature, such as hospitals. Also, ozone laundering is appropriate for facilities that launder large amounts of towels and sheets, such as barracks and other lodging type buildings.

Key benefits to ozonated laundering are:

- ✓ Water savings: Ozone process requires no rinsing.
- ✓ Energy savings: Heated water is not required in the ozone process because cold water absorbs more ozone.
- ✓ Elimination of Detergent: Ozone replaces the need for detergent (except in heavily soiled clothing where detergent is combined with ozone).

Leak Detection and Repair

Water distribution systems often are huge sources of water loss, especially in the case of military bases that have old (pre-1940s) systems. Leaks often occur from loose joints or service connections in the system and corrosion, splits, and cracks along the piping wall. Typically, leak detection is done as part of a comprehensive water audit to help determine the source of unaccounted for water consumption at the site. Leak detection is often done by outside contractors because determining the exact location of a leak requires training and appropriate tools. Leaks are detected by listening devices -- sonic for metal piping or ultrasonic for PVC piping.

A study done by the U.S. Army Corps of Engineers' Construction Engineering Research Laboratory calculated water losses at four Army sites. Water losses ranged from 9% to 36% of the total water consumption at the particular site. Leak detection and repair projects at four Federal sites during 1995-1999 show an average water loss recovery of 144,000 gallons/day and a payback after repair of 18 *days.*

Some of the key benefits to regular system audits, leak detection, and repair programs are as follows:

- ✓ reduced water loss
- ✓ lowering the cost of quality water (pumping, treating, etc.)
- ✓ reduced operating costs
- ✓ increased knowledge of system
- ✓ reduced legal liability and potential property damage due to leaks thus lowering insurance costs
- ✓ safer and more reliable system (less likely to have contaminated water supply, increased reliability of fire protection systems)
- ✓ better use of resources that ensures more reliable supply for the future.

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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