Federal Water Resource Management: How Does It Impact Our Other Resources?

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The Department of Energy's Federal Energy Management Program (FEMP) has been required by statute and executive order to facilitate both water and energy savings in the Federal sector. The goal to save energy—using energy efficiency and renewable energy technologies—is mature and well-practiced at DOE. The goal to save water, however, has not seen much program development. FEMP has now developed a water policy and a water management program and has attempted to prove its value to energy and other savings by implementing water efficient projects at two sites. This paper describes two case studies of water resource management projects and their relationship to a variety of other benefits.

INTRODUCTION

Twenty years ago, energy conservation activists worked from grass roots organizations in an effort to reduce the environmental impact of energy use. Today energy efficiency is common practice and big business—justified by dollars saved, productivity gained and maintenance expenses lowered. The water conservation industry is today what we saw a decade or two ago in energy. Many ''passionate'' players are attempting to affect change by asking us to view and use water differently. The Department of Energy's (DOE) Federal Energy Management Program (FEMP) in legislation is required to look at both energy and water savings. With very little previous Federal leadership in water efficiency, FEMP has attempted to break some ground through implementing pilot projects to test the efficacy of investing in water conservation. Two case studies will be discussed here—projects with very different objectives but with equally compelling arguments for water resource management. Both projects had the primary goal of saving water, but used very different approaches. The first project is technology-based; water-efficient indoor fixtures and outdoor landscape irrigation controls were installed and monitored at the Denver Federal Center. The second project is a total resource management initiative at Kirtland Air Force Base, New Mexico, where point source, end use and waste water treatment issues were all considered. This paper attempts to answer the question of whether it is necessary to consider energy savings to justify implementing water efficient measures. Benefits of these projects will be evaluated from three aspects—partnering to leverage support, managing natural resources, and analyzing cost-benefits of water efficiency projects. This paper comments on technology decision-making as well as on policy and program development.

CASE STUDY #1: DENVER FEDERAL CENTER

The Denver Federal Center began as a test bed for commercial indoor and outdoor water-saving technologies at a typical Federal site. The General Services Administration (GSA) offered that the Federal Center had many typical buildings at the Denver campus, one of which was Building 67 where much of the Bureau of Reclamation is housed. This facility, a fourteen story office building, contained many uses typically found in a Federal building—domestic uses such as toilets, urinals and sinks—as well as significant acreage of landscape irrigation. The mechanism chosen to implement this project was a Cooperative Research and Development Agreement—a CRADA—which provides for testing of donated equipment with no outright dollar investment from the Federal government.[1] The National Renewable Energy Laboratory (NREL), as a DOE laboratory that could legally use the CRADA mechanism, issued a solicitation for indoor and outdoor water efficient technologies and began to select those manufacturers who could participate as partners on the project.

Partnership

The technology solicitation was published twice in the Commerce Business Daily and sent to known manufacturers and associations in the water industry. Many manufacturers submitted proposals and four technologies were chosen based for the most part on feasibility of the technology in this particular location (a vacuum toilet was ruled out, for example, because of its application in new construction rather than retrofits). These four manufacturers then became the donating partners in the CRADA. Federal partners included GSA, DOE and the Bureau of Reclamation. Denver Water, the local utility, also chose to participate. The roles of each of these players allowed the project to leverage resources from a variety of organizations, using appropriate skills and knowledge found within each. The manufacturers provided the technologies and technical oversight in their application. FEMP, through NREL, provided project management, building and end use metering, and technical analysis. The GSA, as property manager, provided plumbers and landscape experts to install the technologies. The Bureau of Reclamation, as the primary occupant, provided customer satisfaction surveys and restroom use data. Denver Water conducted water use audits of both indoor fixtures and the outdoor irrigation system and designed signs for the installed equipment to notify restroom users of the new fixtures. The entire partnership worked together on a signing event as well as a follow up interpretive display installed in the building lobby. Without the multitude of partners contributing specific expertise and resources, the project would not have gained as much upper management support nor would it have obtained such a comprehensive data collection and analysis.

Project Scope

The goal of this project was to install United States manufactured state-of-the-art water efficient technologies at a Federal site, test their actual efficiency, and transfer the results and knowledge to Federal and other sites. A secondary goal was to expend as little Federal appropriations as possible to accomplish the primary goal. The technologies chosen were three indoor plumbing fixtures and one outdoor irrigation technology (Table 1). Building system technologies such as cooling tower products were considered for inclusion in this project, but no industry indicated the willingness to donate such equipment.

Table 1. *Chosen Technologies, Manufacturers, and End Uses*

Technology	Manufacturer	End Use
ULF Wall-Hung Toilet	American Standard	toilet—all test restrooms
Non-water using urinal	Waterless Company	urinal—men's restrooms
Sensored lavatory	Bradley Corporation	sink—all test restrooms
Irrigation controls	WaterLink Systems, Inc.	outdoor landscaping

Data Collection

To demonstrate the measured results of these technology retrofits, partners agreed that it would be critical to determine the water use baseline on both the building and restroom end use level. Water meters were located at only two exterior sites. An ultrasonic flow meter was installed and measured total building water use. Several ultrasonic flow meters were then used to measure use per restroom and then per end use technology. Thus each toilet, urinal and sink to be retrofit was measured prior to the new equipment installation. In addition, toilet use was measured on a per flush basis to measure the amount of gallons per flush used by each plumbing fixture. Leaks in the lines could also then be detected and corrected. After retrofits were completed, meters were installed on the new equipment to measure actual water savings.

Benefits

The direct water savings were measured and graphed by end use on both hourly and daily increments. The below graphs indicate the savings found in one men's room for toilet and urinal retrofits only. The water savings was significant and is expected to be even more so with sink water savings (Figures 1, 2).

The cost of water in the Denver area ($2.10/1000 gallons including sewer) is very low, so the dollar savings from such a project, although 60% of the water use could be saved, is not significant. Comment cards were made available in the rest rooms to obtain subjective opinions from building occupants). Signs over retrofit equipment alerted users about the new water-efficient fixtures. Service calls were tracked as well to ensure that maintenance costs were not increasing as a result of the new equipment. Less quantifiable benefits included the potential of reduced run-off of fertilizers into the ecosystem (less overwatering), and less solid waste grass cutting to be disposed of (fewer mowings). Consideration

Figure 1. *Daily Men's Room Retrofit Data*

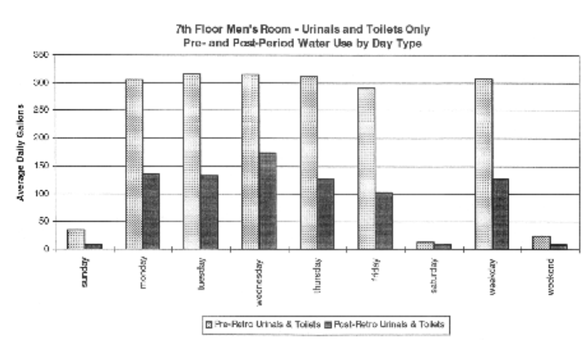
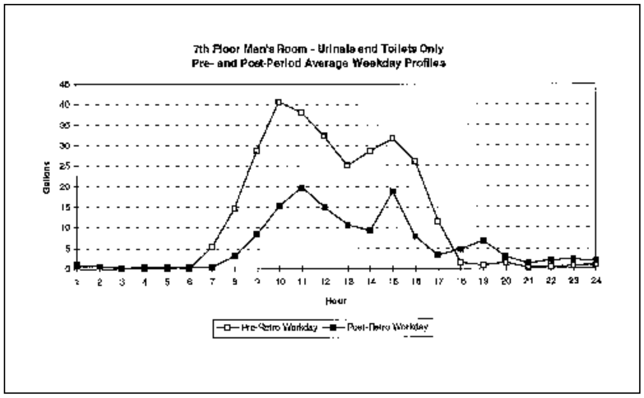


Figure 2. Hourly Men's Room Retrofit Data



was given to all potential project benefits or negative impacts resulting from this initiative to obtain a balanced and comprehensive analysis of the project. The more widespread benefit, certainly, is that successful installation of these technologies at this site could be replicated in Federal and other similar facilities. Demonstrating that the equipment could work in a Federal facility also enabled the manufacturers to have their products added to the Federal Supply Schedule so that other government sites could easily purchase the equipment.

CASE STUDY #2: KIRTLAND AIR FORCE BASE

Kirtland Air Force Base is located in Albuquerque, New Mexico, an area served by the Middle Rio Grande Basin aquifer which was once thought to be the size of Lake Superior. Making Albuquerque, a high desert town, into a ''green'' city was a long-time notion that has been dispelled by the results of a recent United States Geological Survey study. In twenty years, if the aquifer continues to be drained at its current rate, it will no longer be cost-effective to dig wells to obtain drinking water. The City of Albuquerque implemented aggressive water conservation legislation and policy that could mitigate the effect on the aquifer. As the largest water user in the area and in an effort to be a good neighbor for Albuquerque in protecting its natural resources, Kirtland determined to implement a water management partnership.

Partnership

This partnership differs from the Denver Project in the players, the leveraging method, and the project scope. A key player in this project is the electric and gas utility in New Mexico—Public Service Company of New Mexico (PNM). PNM through an areawide contract with GSA (General Services Administration) is able to provide a multitude of services to its Federal customers, including audits, design and installation of both energy (electricity and natural gas) as well as water infrastructure and equipment. Much of the project was able to happen through this utility partnership. Other key players in this initiative were certainly Kirtland Air Force Base as the model site and facility staff resource, FEMP through NREL as project facilitator, the State of New Mexico as an informational resource, the City of Albuquerque as a water policy example and neighbor, and the Bureau of Reclamation and Sandia National Laboratories as technical consultants. All partners had input into all meetings, documents, and projects concerning the project.

Project Scope

Since the water resource situation in the Albuquerque area has reached such critical proportions, the project needed to have a more comprehensive scope than the Denver project. Rather than testing a few select technologies in a contained number of locations, a whole water resource plan has been developed to look at all possible methods of deploying water savings. Kirtland had already begun to implement water efficiency and had received a FEMP award as a result of their aggressive efforts. Building on this success, the partners developed a Water Resource Management Policy and Action Plan, which included a metering plan (to help determine a baseline, then measure actual savings and attribute them where appropriate), a public awareness plan (to ensure that employees, residents, maintenance staff and school children all began to shift and expand their views of water conservation), operations and maintenance plan (including best management practices and leak detection plan), and goals, milestones and resources to accomplish these. The first steps taken in implementing this plan have been to install meters on the golf course and family housing blocks. PNM has begun providing comprehensive water audits of the site to determine infrastructure, building, and process retrofit options. This policy, signed by the 377th Air Base Wing Commander and other leaders at the Base, set the stage for implementing this all-encompassing water resource management policy and plan.

Benefits

The true test of this project was to see a lessening and sustainable impact of the Base on the Middle Rio Grande Basin aquifer. Since only a few projects have been started, only projected benefits are available. With a goal of 30% water use reduction by the year 2005 (from a 1995 baseline since Kirtland had already reduced usage significantly from their 1985 baseline), the site would reduce at a minimum 65 million gallons per year, virtually eliminating the need to dig more wells to the aquifer, even with potential site development and growth. The greater the ability to convert from potable water to re-use, the lesser the drawing from wells into the aquifer (Figure 3).

Table 2. Projected Direct and Indirect Energy and Water Savings

Conservation Method	Number of Installation	Total Cost	Annual Savings ($) Direct Water	Direct Energy	Indirect Energy	Payback Time Direct Only
Installation of ULF toilets and urinals	238	$70,210	$10,423	$0	$1,143	6.74
Installation of automatic faucets	110	$32,450	$4,033	$4,216	$1,128	3.93
Installation of faucet aerators	0	$0	$0	$0	$0	NA
Low Flow showerhead	11	$3,245	$9,843	$12,346	$3,089	0.15
Boiler blowdown optimization	1	$0	$7,134	$40,581	$786	0.00
Efficient dishwashers	3	$975	$73	$153	$33	4.30
Efficient washing machines	7	$2,975	$794	$415	$155	2.46
Landscape irrigation optimization	NA	$38,984	$77,968	$0	$8,547	Annual
Total (excluding Landscape)		**$109,855**	**$32,301**	**$57,712**	**$6,334**	**1.22**

Interestingly, PNM has recognized that using less water at their Federal customer sites will lead to less pumping, heating, and treating demands created on their electric and gas sources. A more global benefit of this partnership is the model it proposes for water resource management at Defense Department and other Federal facilities.

LINKING WATER TO ENERGY SAVINGS

We have known, more intuitively than quantitatively, that water savings causes energy savings—direct, through reduced hot water use, and indirect, through reduced pumping and treating uses. WATERGY, A Lotus spreadsheet, was developed in conjunction with George Mason University to calculate these potential energy savings. To use the program effectively, one must know monthly water and energy costs and water usage. In the cases of the Denver Federal Center and Kirtland Air Force Base, the usage and cost numbers are based on well and total site metering, with no breakdown by building. It is impossible, therefore, to determine end use water efficient measures and associated energy savings with this program until submetering and separate billing is in effect. This program is effective where the building is separately metered for water, gas, and electricity. The following is an example of a large Federal agency headquarters building in Washington, DC, showing water and energy savings potential through water efficient retrofits (Table 2, Figures 4, 5). The potential energy savings are far more compelling than the water savings. As Federal agencies begin to submeter, and as the prices of both energy and water rise, economic analyses of this type will assist in determining energy savings potential of water efficiency.

Figure 3. *Kirtland Air Force Base Water Reduction Goal*

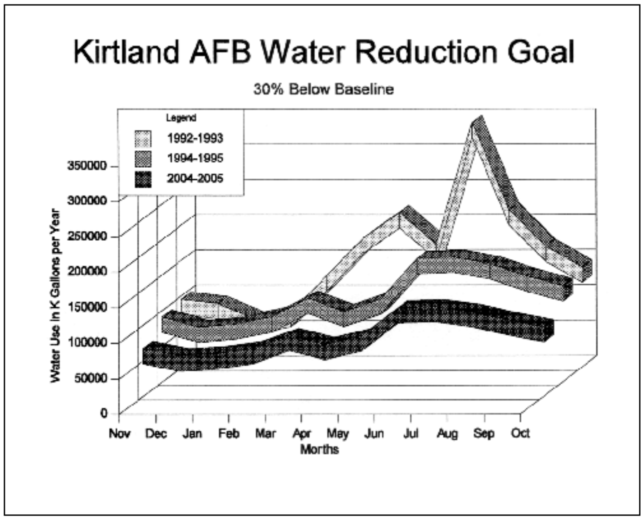


Figure 4. Projected Water and Energy Savings Payback

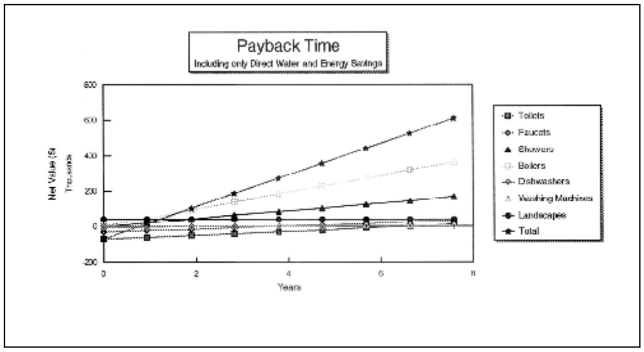
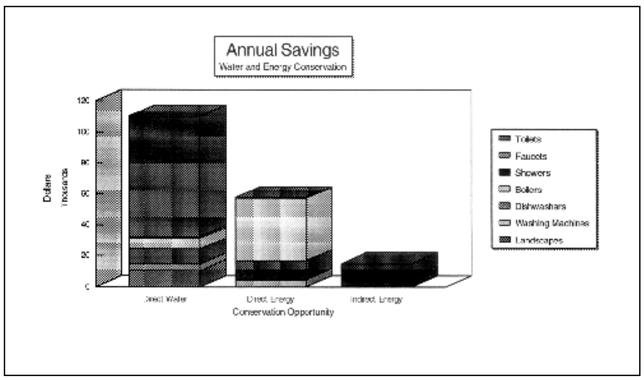


Figure 5. Projected Annual Energy and Water Savings



CONCLUSIONS

The two case studies, although equally important and viable, took very different approaches—leveraging different mechanisms and implementing different project scopes. The overarching premise that water savings leads to other savings—energy, labor, and environmental—points to the necessity of undertaking water efficient projects at Federal sites. Ideally, all resources should be considered at the same time a standard energy audit is performed[2]. Federal sites should be evolving to sustainable and less environmentally harmful sites. The first order of business on the energy side, we propose, is to include water in the equation.

ACKNOWLEDGEMENTS

Thanks is due to Christine Ervin, Assistant Secretary of Energy Efficiency and Renewable Energy at the Department of Energy for taking a risk to support the pursuit of Federal water conservation. We would like also to thank the partners in both the Denver Federal Center and the Kirtland Air Force Base projects for their willingness to take risks to effect change. None of these efforts would have been successful without the continuing support and contributions of these players.

ENDNOTES

1. Stevenson-Wydler (15USC 3710) Cooperative Research and Development Agreement (CRADA).

2. FEMP's SAVEnergy program includes water conservation and renewable energy in addition to the standard energy conservation measures.

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