Alliance for Water Efficiency

Transforming Water:

Water Efficiency as Infrastructure Investment

Position Paper

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About the Alliance for Water Efficiency

The Alliance for Water Efficiency is a stakeholder-based nonprofit organization dedicated to the efficient and sustainable use of water. Headquartered in Chicago, the Alliance serves as a North American advocate for water-efficient products and programs, and provides information and assistance on water conservation efforts. A diverse Board of Directors governs the organization and has adopted a set of guiding principles and strategic plan.

The Alliance website contains a wealth of information on conservation programs and practices. We invite you to visit us for further information at **www.allianceforwaterefficiency.org**

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Transforming Water: Water Efficiency as Infrastructure Investment

Summary

Water efficiency programs have an established track record as cost-effective long-term public resource investments. Less well understood are the short-term economic impacts of these rapidly scalable and adaptable programs, and the ability of these programs to quickly deliver economic benefit as well as sustainable solutions. This paper quantitatively examines the short-term economic growth impacts of water efficiency investments, specifically in terms of job creation, income, GDP, national output, water savings, and other benefits.

Our consultant team modeled a wide range of water efficiency program possibilities, across all water-using sectors and included indoor, outdoor, and water system efficiencies. This modeling clearly confirms that economic benefits could be broadly distributed throughout the national economy:

1. Economic output benefits range between $2.5 and $2.8 billion per billion dollars of direct investment.
2. GDP benefits range between $1.3 and $1.5 billion per billion dollars of direct investment.
3. Employment potential ranges between 12,000 and 26,000 jobs per billion dollars of direct investment.

Thus, direct investment on the order of $10 billion in water efficiency programs can boost U.S. GDP by $13 to $15 billion and employment by 120,000 to 260,000 jobs and could save between 6.5 and 10 trillion gallons of water, with resulting energy reductions as well.

The economic benefits from these investments are comparable to other public infrastructure investment options, with the important added advantage that they can be deployed in short time frames and can be readily scaled according to need. The long-term strategic, economic, social, and environmental benefits of these programs also make them “no-regret” investments in the nation’s future.

This modeling clearly confirms that economic benefits could be broadly distributed throughout the national economy.

Introduction

When considering water system related investments, it is important to avoid only thinking about reconstructing existing infrastructure. Investments in water-use efficiency improvements are important and beneficial. This position paper labels these investments as "water efficiency" programs, and includes:

- **Investments in improved indoor water-use efficiency that yield the same or improved customer benefits while using less water**—such as high-efficiency toilets, clothes washers, dishwashers, showerheads, and faucet aerators.
- **Investments in improved outdoor water-use efficiency**—such as smart irrigation controllers, improved irrigation equipment, and real-time irrigation efficiency monitoring.
- **Investments in commercial/industrial/institutional water-use efficiencies**—such as cooling tower retrofits, plumbing fixture replacement, commercial kitchen upgrades, and process water improvements.
- **Water utility efficiency improvements**—including system leak detection and control, energy efficiency audits, and water rate reform.

Though this paper focuses primarily on quantifying the employment and income benefits of investments in water efficiency programs—in terms of increased economic activity and total jobs created—there are also important qualitative benefits of water efficiency investment:

1. Water efficiency programs connect directly to communities, necessitating citizen involvement.
2. Water efficiency programs empower water customers to control their water bills.
3. Water efficiency will be a 21st century growth industry, and these programs can firmly reinforce the position of U.S. manufacturers as leaders in water efficient technology innovation in product design.
4. Water efficiency programs directly address distressed communities, where water distribution infrastructure has not been adequately maintained or replaced, and where household and commercial appliance stocks tend to be older and less efficient.
5. Water efficiency programs can help reduce long-term political conflicts between regions.
6. Water efficiency programs can vastly reduce the use of energy to pump, treat, and pressurize water systems.
7. Increasing water efficiency can forestall the need for energy-intensive new water supply development.
8. Reduced energy requirement results in an increase in national energy independence.

Methodology

An input-output (I-O) model of the U.S. economy was used to evaluate the near-term economic benefits of large-scale investments in water efficiency programs. Near-term economic benefits were measured in terms of creation of jobs and labor income, and contribution to gross domestic product (GDP) and national output. Impacts were evaluated with IMPLAN I-O modeling software and the 2015 national data file.

Several types of water efficiency program investments were evaluated. These included:

- Rebate and direct install programs aimed at replacing older, less efficient appliance and plumbing fixture stock;
- Outdoor water-use programs involving landscape surveys and equipment upgrades;
- Commercial/industrial cooling tower retrofits;
- Industrial process water improvements; and
- Water utility leak detection and system water loss reduction programs.

In all cases, program specifications and cost estimates were based on actual water efficiency programs developed for U.S. municipal water utilities.

Program expenditures were subdivided into the following categories:

- Expenditures for repair, maintenance and new construction;
- Expenditures for new physical assets;
- Expenditures for site inspections, installation, and other services; and
- Expenditures for program administration.

Category-specific unit expenditures were developed for each program (e.g., physical asset costs per toilet replaced or per cooling tower retrofitted).

The category-specific unit expenditures were then mapped to the appropriate economic sectors in the IMPLAN I-O model.[1] Unique mappings were done for each water efficiency program to account for the different expenditure patterns across the programs. In cases where program expenditures involved purchases from retail or wholesale suppliers, IMPLAN's margining capability was used to account for the entire value chain from manufacturing to transportation and warehousing and then to wholesale and retail distribution. In situations where product manufacturing involved multiple stages or processes, expenditures were further divided to account for all manufacturing steps (e.g., high-efficiency toilets involve ceramic, plate metal, plastic, and possibly wood manufacturing sectors).

The analysis assumes that federal funding of water efficiency programs would be structured to support domestically produced products (e.g., toilets, irrigation equipment) to benefit the U.S. manufacturing sector.

In cases where programs involved cost-sharing with end-users (e.g., a rebate program that covers half the cost of a new appliance or water using device) it was assumed that end-users would offset program-induced expenditures by an equivalent reduction in expenditures on other goods and services. In other words, the analysis took the conservative stance that these programs would redirect business and household expenditure into efficiency investments, but not increase overall spending beyond already planned or anticipated levels. In this way, the methodology only counted the economic benefits associated with direct investment from the water efficiency program expenditures, and does not double count benefits from economic activity that would likely have occurred anyway.

The changes to sector final demands resulting from the program mappings were run through the IMPLAN I-O model to determine the impacts to employment, income, GDP, and national output. Total impacts estimated with the model consist of the direct and indirect impacts of program expenditures. The direct impacts include jobs, labor income, and output associated with the direct spending by the water efficiency programs. The indirect impacts result from the ripple effect of this spending on related industries and disposable household income.

[1] The IMPLAN model includes 536 separate economic sectors. IMPLAN sectoring is based on the North American Industry Classification System and the Bureau of Economic Analysis U.S. Benchmark Tables.

Results

The economic benefits per billion dollars of direct investment for the range of programs evaluated are shown in Table 1. Output benefits range between $2.5 and $2.8 billion per billion dollars of direct investment. GDP benefits range between $1.3 and $1.5 billion per billion dollars of direct investment. Employment potential ranges between 12,000 and 26,000 jobs per billion dollars of direct investment.

The programs in Table 1 were selected for illustrative purposes only. Other programs of similar design focusing on other aspects of water efficiency would be expected to provide similar employment and income benefits.

Thus, direct investment on the order of $10 billion in water efficiency programs similar in scope to those shown in Table 1 has the potential to boost U.S. GDP by $13 to $15 billion and employment by 120,000 to 260,000 jobs.

Table 1

Economic Benefits per Billion Dollars of Direct Investment

Total impact per billion dollars of direct investment	*Billion $, except employment*			
Program Option	*Output*	*GDP*	*Labor Income*	*Employment*
Water System Loss Control	$2.6	$1.4	$0.9	12,000
Landscape Irrigation Upgrades	$2.8	$1.3	$0.8	16,000
HE Toilet Replacement Program	$2.6	$1.5	$1.0	18,000
Industrial Water Upgrades	$2.6	$1.5	$1.0	25,000
Cooling Tower Upgrades	$2.5	$1.4	$0.9	15,000
Restaurant Equipment Rebates	$2.6	$1.5	$1.0	26,000

**Impacts calculated using IMPLAN Pro Version 3.1.1001.12 and 2015 national economy data file.*

The model results indicate that economic benefits would be broadly distributed through the national economy. Table 2 shows the distribution of GDP and employment benefits at the 2-digit NAICS level of sector aggregation, assuming $10 billion of direct investment in water efficiency programs.[2]

[2] Table 2 assumes direct investment is divided evenly across the programs shown in Table 1.

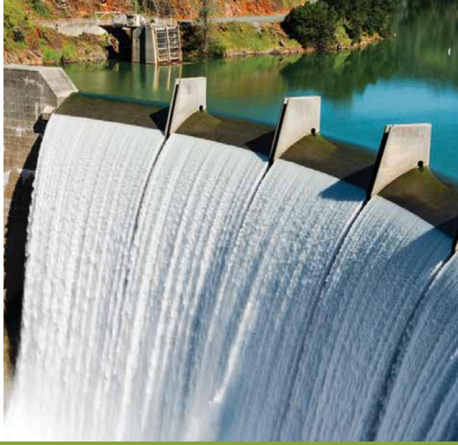

Table 2

Distribution of Benefits from $10 Billion of Direct Investment in Water Efficiency Programs

Economic Sector *2-digit NAICS*	GDP *Billion $*	Employment *Jobs*
11 Agriculture, Forestry, Fishing & Hunting	$0.08	1,167
21 Mining	$0.15	833
22 Utilities	$1.22	5,833
23 Construction	$0.18	2,333
31-33 Manufacturing	$1.68	13,000
42 Wholesale Trade	$0.80	4,833
44-45 Retail Trade	$2.15	63,667
48-49 Transportation & Warehousing	$0.43	5,500
51 Information	$0.43	1,667
52 Finance & Insurance	$0.80	5,833
53 Real Estate & Rental	$1.33	5,000
54 Professional–Scientific & Technical Services	$0.66	7,167
55 Management of Companies	$0.25	1,833
56 Administrative & Waste Services	$0.75	17,333
61 Educational Services	$0.09	2,000
62 Health & Social Services	$0.63	10,000
71 Arts- Entertainment & Recreation	$0.10	2,000
72 Accommodation & Food Services	$0.30	7,667
81 Other Services	$1.75	21,500
92 Government	$0.57	6,667
Total	**$14.34**	**185,833**

Water Savings

The estimated costs for the diverse range of water efficiency programs yield water savings at unit costs ranging between $199/million gallons (rate reform/water budgets) and $1,900/million gallons (industrial process), with an average around $673/million gallons. An accurate accounting of water savings depends on the exact mix of programs implemented, so savings estimates must be general until it is known what the programs are that will be selected. Plumbing fixtures cannot be replaced twice for double the water savings, for example. It is conservatively estimated that a well-implemented set of programs could yield water savings in the range of $1,200-$1,800/million gallons.

Thus, the water savings from a $10 billion water efficiency investment could be as follows:

- For a range of water efficiency programs costing on average $1,200/million gallons, cumulative savings of 8.3 trillion gallons of water, or 2.3 billion gallons per day.[3]
- For a range of water efficiency programs costing on average $1,800/million gallons, that same investment of $10 billion would yield cumulative savings of 5.6 trillion gallons of water, or 1.5 billion gallons per day.

The scale of this volume of water is equivalent to four to six percent of water supplied by public water systems in the United States.[4]

Rapid Deployment Potential

Water efficiency programs can be rapidly deployed and scaled to need. These are key advantages compared to traditional water supply development projects, which can take decades to permit and construct. Because water efficiency programs require much less time to plan and deploy than do large infrastructure works, by directing infrastructure investment into water efficiency program deployment, Congress can hit the ground running while it mobilizes resources for larger infrastructure projects. The feasibility of rapid deployment of efficiency programs has been proven over many years by western U.S. water managers responding to periodic droughts and shortages. There now exists a range of demonstrated approaches for quickly deploying efficiency programs in the field, initiated in time periods of 180 days or less.

[3] This assumes program water savings have an average life of 10 years.

[4] Based on U.S. Geological Survey 2015 estimates of public water system deliveries of 39 billion gallons per day.

Aid for Distressed Communities

Some of the best opportunities for water efficiency investment are in lower-income areas where water distribution infrastructure has not been adequately maintained or replaced and where household and commercial appliance stocks tend to be older and less efficient. The City of Los Angeles pioneered the use of community-based-organization (CBO) deployment models for ultra-low-flush toilet installation in the early 1990s. Working with local CBOs not only helped the city to replace over 2 million toilets, but also created employment opportunities where unemployment rates were highest. Many water efficiency programs do not require highly skilled labor to implement. These types of programs are well suited for assisting communities throughout the country suffering from endemic underemployment.

"No-Regret" Investments in the Nation's Future

The long-term strategic, economic, social, and environmental benefits of water efficiency programs make them "no-regret" investments in the nation's future. Investing in these programs now will, over the longer term, boost U.S. manufacturing, help advance national energy policy, promote sustainable resource use, contribute towards GHG emissions reduction, and lessen mounting regional conflicts over water resources.

Diffusing Regional Water Conflicts

Pressures on the nation's overstretched fresh water resources are spawning regional conflicts over water resources. Wrangling among Colorado Basin states is intensifying, and states in the southeast are now locked in legal battle for control of fresh water supply.

In every case, the source of conflict is the same: demands for fresh water are outpacing available supplies. California has reached a point where there is simply not enough water to meet the demands of industry, agriculture, and households in an environmentally sustainable way unless new ways to do more with less are found. The passage of Senate Bill X7-7 in 2009 required the State to achieve a 20 percent reduction in urban per capita water use by 2020. Similarly, the Texas Water Development Board's 2017 State Water Plan reports that, "Without additional supplies, approximately one-third of Texas' population would have less than half of the municipal water supplies they will require in 2070." Las Vegas is now paying homeowners to rip out their lawns and taking other drastic actions to save water. These imbalances have prompted the Interior Department to warn that, "explosive population growth and the emergence of the demand for water for environmental restoration and attainment of the goals of the Endangered Species Act will typically define the extent and severity of water supply-related conflicts." Water-use efficiency investments will be a key component of policies intended to address these imbalances.

Contribution to National Energy Policy

The water and energy sectors are highly interdependent. Water utilities and water customers use enormous amounts of energy to withdraw, treat, and distribute water. Thus, saving energy becomes one of the most compelling reasons to save water: it is good for the economy and good for the environment in terms of reduced oil dependence as well as greenhouse gas reduction. Both water and energy efficiency reduce other negative externalities as well. Saving water also saves chemicals produced in energy-intensive processes. Thus, the advancement of water efficiency must be part of the "low-hanging fruit" that can be captured as part of a comprehensive energy policy.

Water utilities can save energy with efficient pumps and efficient pumping practices, including off-peak pumping to adequate storage. Water and wastewater utilities may also find ways to cogenerate energy onsite in order to reduce electricity demands. Infrastructure improvements that reduce leakage and losses also save both water and energy. Efficient water use by all customers (industrial, commercial, and residential) provides across-the-board savings by avoiding energy costs throughout the entire production cycle. Reductions in hot water use directly save both energy and water, with appreciable benefits to households. Smart meters may play a role in promoting both water and energy efficiency.

Bold leadership and policies are needed to help realize the opportunities presented by the energy-water nexus. The time has come for more explicit integrated approaches to water-energy management. Water efficiency cannot displace water infrastructure, but it can become an integral part of the infrastructure. Water systems and water usage in the U.S. are far from optimal. The costs are paid by the environment and the economy in terms of both water and energy.

Consider these energy consumption facts:

The California Energy Commission has documented that 19% of the state's electric energy load is related to the pumping, treatment, distribution, and consumer end use of drinking water and the collection and treatment of wastewater.

A full 32% of the state's natural gas load is related to the heating of consumer end use hot water.

The Commission documented that 95% of its energy efficiency goals could be met with water efficiency programs at 58% of the cost, thereby demonstrating the clear cost effective value of water efficiency programs.

The California State Water Project is the largest single user of energy in the state, consuming an average of 25% of the total electricity consumption for the entire state of New Mexico. In the process of delivering water to Southern California, the project uses 2-3% of all electricity consumed in the state.

A previous study documented that 4% of the nation's electricity use goes towards moving and treating water and wastewater, although that figure is deemed by most experts to be much lower than the actual national average.

Approximately 80% of the variable costs for processing and distributing municipal water supply are for electricity.

Groundwater supply from public sources requires roughly 2,100 kilowatt-hours per million gallons—about 30% more than supply from surface water, primarily due to a higher energy requirement to pump from groundwater.

For more information:

Alliance for Water Efficiency
Water-Energy Nexus Research: Recommendations for Future Opportunities
http://www.allianceforwaterefficiency.org/Water-Energy-Research-Needs-White-Paper.aspx

California Energy Commission
Integrated Policy Report:
http://www.energy.ca.gov/2005publications/CEC-100-2005-007/CEC-100-2005-007-CMF.PDF

Center for Sustainable Systems
U.S. Water Supply and Distribution Factsheet:
http://css.umich.edu/factsheets/us-water-supply-and-distribution-factsheet

United States Department of Energy
Energy Demands on Water Resources Report to Congress
on the Interdependency of Energy and Water:
http://www.allianceforwaterefficiency.org/uploadedFiles/resource_center/library/water_and_energy/doe_2006-waterenergy-report.pdf

About this report:

This report was originally published in 2008. The modeling and analysis done for the original report has been updated using the latest available IMPLAN national data file. There are small differences between the IMPLAN sectoring used in the original and the updated analyses due to differences in the underlying structures of the IMPLAN data files. The 2007 IMPLAN data used for the original analysis divided the economy into 440 unique sectors. The updated analysis, which uses 2015 IMPLAN data, divides the economy into 536 unique sectors. Water efficiency program cost estimates developed for the original report have been adjusted for price inflation using the GDP price deflator for the U.S. economy prior to their use in the IMPLAN model. The updated analysis assumes that federal policies that favor procurement from U.S. manufacturers would be in place, whereas the original analysis did not make this assumption.

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