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Do Water Audits Work?

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Many water utility companies are exploring ways of promoting water conservation to help manage demand and supply imbalances. Such conservation has the potential to address water shortages, which are projected to be severe in many parts of the world and could affect billions of people by 2050. One increasingly common mechanism to help promote conservation is an online residential water audit, which helps identify behavioral and technological inefficiencies in the home and provides tailored recommendations for conserving water. The Environmental Protection Agency considers water audits to be a critical first step in identifying and quantifying water uses and losses. Many public water systems have begun to promote water audits. However, little is known about the efficiency and cost-effectiveness of audits. Our research helps fill this gap by implementing an experiment that encourages customers to complete an online home water audit. Our results suggest that even though water audits help to reduce household water consumption, the costs associated with encouraging households to complete an audit likely outweigh the environmental benefits.

We partnered with Northumbrian Water Group, a water utility company in the United Kingdom, and randomly allocated 45,000 residential customers into either a control group that received no communication or one of six treatment groups that each received a different letter encouraging them to complete an audit. The first treatment group received a letter already used by the utility company. The other treatment groups received newly designed letters, each catering to a different motivation for water conservation: the second letter was a simplified version of the original letter that made the call to action more salient; the third letter suggested that users save water to protect their local environment; the fourth letter compared the recipient's household consumption with that of their neighbors; and the final two letters provided a monetary incentive of either £10 ($12.81) or £15 ($19.21) for completing the home water audit.

The letters encouraged customers to take a do-it-yourself

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online water audit. This self-audit involves logging into the company's online water audit tool, answering questions on water use habits and home features, and receiving recommendations for reducing consumption. The online tool provides information on free water-saving devices offered by the utility company and helps customers book an in-home audit if appropriate. We measured water consumption after sending the letters and compared it with water consumption of households in the control group.

Our research finds that all letters led to a significant increase in completion of audits relative to that of the original letter for about two months and that the letters offering a monetary incentive had the most impact. Specifically, the rate of audit completion increased by 4.5 percentage points for households offered the £10 incentive and 5.7 percentage points for households offered the £15 incentive. Thus, increasing the financial incentive could be a fruitful strategy to increase participation in water audits.

Next, we estimated the short-run impact of audits on water consumption for metered households. Our analysis suggests that completing the audit reduces water consumption 17–18 percent (43–45 liters per day) for metered households. These effects persisted for at least two months after the audit. Additionally, we estimate that the £15 treatment reduces consumption by 44 liters per day for metered households and the £10 treatment reduces consumption for the same group by 43 liters per day. This suggests that though the size of the subsidy is important for audit completion, it may not be that important for water conservation. Furthermore, we conducted a survey and found that the conservation resulted from behavioral changes (including shorter showers, detecting leaks, and turning off taps) and the installation of water-saving technologies.

Our research also finds, however, that though the audits lead to fewer greenhouse gas emissions, the net benefits are close to zero. Water providers and customers generate greenhouse gas emissions by using energy to pump, treat, and heat water and manage wastewater, which is why decreasing water usage reduces greenhouse gas emissions. We combined conservation's benefit of reduced emissions with the four aspects of the program that incur the most costs—mailing the letters, fulfilling the financial incentives, lost utility revenue, and time spent completing the survey—to produce net benefits per person. If we translate the net benefits into monetary value, these figures range from −$1.90 to $2.10; the higher number is achieved only under the assumption that conservation persists over the long run and that water utility companies can raise prices to avoid revenue losses. Specifically, we quantified the decreases in greenhouse gas emissions associated with reductions in water consumption and converted those reductions in greenhouse gas emissions (that is, the emissions that would have been released but were not) to carbon dioxide equivalents. Through this, we found that the societal costs of emitting carbon would need to be $1,200 per ton for the £10 incentive program's benefits to equal its costs if there were no other benefits—this is about 22 times higher than standard estimates of carbon damage, which are around $51 per ton. Therefore, notwithstanding the substantial improvements in water conservation, no letter program appears to pass a benefit-cost test over the short run.

Since our analysis does not quantify all potentially important benefits, we defined a lower boundary on other benefits that would need to be reached for the program to pass a benefit-cost test. Our results suggest that a cubic meter of water conservation would need to yield other benefits (such as reduced water infrastructure investment costs) of about $8, or 10 times the price of that amount of water, for the letter program to be worthwhile.

Additionally, we estimated the net emissions-reduction benefits generated by each public dollar spent on the financial incentive program. Our estimates range from −$0.074 to $0.0048. If we assume that emissions-reduction benefits last for at least a year and that the utility company breaks even, the estimate increases to $0.28. This implies that $1.00 of government spending generates $0.28 of net emissions-reduction benefits.

Finally, our experiment also explored whether targeting the letters could improve their effectiveness. We focused on high users, whom we define as customers consuming more water than the median household. Our results indicate that targeting high users with financial incentives roughly doubles the reduction in consumption (89 liters per day versus 44 liters per day without financial incentives) over the short run.

This suggests that targeted audits are more efficient than nontargeted audits. However, our results show that targeting is not sufficient for emissions-reduction benefits

to exceed the program's costs in the short run, but they can help in the long run. Targeting helps improve cost-effectiveness by 47 percent ($4.40 per cubic meter versus $8.40 per cubic meter without targeting), but our estimates reveal that a cubic meter of water conservation would need to yield other benefits or reduce water infrastructure investment costs by at least $3 for the targeted letter program to pass a benefit-cost test.

Our results show that the short-run reductions in greenhouse gas emissions from water conservation are small—around 1.6 tons for 65 days. While the total cost of the experiment per person is also relatively small, around $1.70 per customer, this leads to a cost-effectiveness of $1,100 per ton, which is much higher than most estimates of the societal harm of carbon. If we assume that our results persist for a year and that utilities break even, then the cost-effectiveness is more attractive ($190 per ton) because the emissions-reduction benefits from conservation increase.

NOTE

This research brief is based on Jesper Akesson et al., "Do Water Audits Work?," National Bureau of Economic Research Working Paper no. 31831, November 2023.