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Increasing consumer benefits & engagement in AMI-based conservation programs

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Executive summary

This report presents findings from a study of how Advanced Metering Infrastructure (AMI) can be used to promote residential water conservation. It integrates results from an extensive literature review, a survey of 322 U.S. utilities, 11 in-depth interviews with utility managers, and four field experiments on encouraging engagement with AMI portals. The report maps utility experiences with the roll-out of AMI and discusses how utilities can apply behaviorally-informed strategies to improve customer engagement with, and the efficacy of, AMI portals.

Most U.S. water utilities are now moving toward full AMI deployment. With the provision of near real-time consumption data and personalized feedback, AMI promises to help consumers achieve significant water savings. However, many utilities face difficulties when attempting to fully leverage the potential of AMI. One key challenge is insufficient customer engagement with the new AMI customer portals. This report shows that behavioral interventions can be effective in promoting customer engagement and water conservation through AMI portals, provided they are applied and evaluated consistently. We summarize the main project findings below:

1. ***Correlational* studies suggest that AMI portals can promote water conservation. However, their efficacy depends on several factors.** These include individual and household characteristics, customer engagement with the portals, the integration of portals into other customer platforms, whether portal features are default options, and how communications are designed and targeted.
2. **Little is known about the *causal* effects of AMI portals on residential water conservation.** We found that signing up for an AMI portal led to an average decrease in daily water usage in the range of 6.3 to 12.1%. However, the observed decrease did not reach the threshold of statistical significance. The lack of *statistical* significance does not mean that portals are ineffective (the sample size may simply have been too low to detect the effects of the portal). More rigorous evaluations of AMI portals involving larger sample sizes need to be conducted to provide a conclusive assessment of the efficacy of AMI portals (and the determinants of said efficacy).
3. **Providing access to AMI portals does not automatically translate into customer sign-ups and engagement.** A previous review of 25 published studies showed that average AMI portal sign-up rates range between 30% and 45% (Liu & Mukheibir, 2018). However, our interviews with U.S. utility managers reveal that portal registration rates can vary much more (4% to 71%), with the majority of utilities leaning toward the lower end of this spectrum.
4. **Reducing behavioral frictions associated with portal sign-ups appears to be a particularly effective strategy to increase portal uptake.** In particular, enabling customers to access their AMI data from environments they are already used to (e.g., their online billing portal) and without the need for another set of log-in

credentials can substantially increase the number of customers accessing the AMI portal. However, more *registered* users do not necessarily equate to more *active* users. To maximize the impact of AMI portals on water consumption, utilities must continue with their outreach and engagement strategies to help turn registered customers into active portal users.

5. **Invitations and reminders to sign-up are a simple yet powerful tool that can help boost portal registrations.** In our field trials, we found that sending two simple emails (one invitation and one reminder) that included the portal registration link and also explained the benefits of the AMI portal led to an additional increase of at least 109% in portal registration rates, as compared to customers who did not receive any emails. Interestingly, we tested multiple versions of the email communication and most of them achieved the same impact. This suggests that receiving a call to action was more important in driving additional portal registrations than the precise wording of the communication.
6. **Promoting AMI at moments when customers are most receptive to saving water generates the highest conversion rates.** Outreach in moments when customers tend to be most sensitive about their water use—such as when they are experiencing a potential leak, paying a water bill, calling a utility customer service representative, or facing an upcoming drought in the region—appears to have the highest chances of success in getting a customer to sign-up for the portal.
7. **AMI-related communications should be tailored to the needs of different customer segments.** Understanding the needs of different customers is a prerequisite for a successful AMI promotion strategy. For example, whereas commercial customers seem to be more attracted to the prospect of continuously saving water and money, residential customers often seek to avoid leaks and manage their water consumption as effortlessly as possible. Through research, e.g. by utilizing customer surveys and interviews, utilities can identify what most resonates with their particular customer segments and tailor AMI-related communications to these groups for improved effectiveness.
8. **To identify which engagement strategies work best in a given context, utilities must move toward experimentation.** Existing causal evidence on AMI engagement strategies is scarce and often comes from different countries and contexts. Utilities ought to work toward generating their own evidence of "what works". Agencies that are able to adopt an experimental mindset and employ rigorous testing methods—such as field trials and A/B testing—are best positioned to test different engagement strategies, identify what works best in different contexts, and make evidence-based decisions.
9. **Once adopted by a sufficiently large number of consumers, AMI portals can facilitate the delivery of behavioral interventions to further promote water conservation.** Several rigorous studies show that utilities can make their AMI portals more engaging through the application of different behavioral science strategies. By tapping onto behavioral insights, utilities can make AMI more effective in helping customers conserve water and the environment.

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01 Introduction

Advanced Metering Infrastructure (AMI)—also commonly referred to as smart meters—is an integrated system of meters and information systems that enables two-way communication between utilities and customers. Many utilities around the world in the gas, electricity, and water sectors are implementing some form of AMI. A major motivation for using AMI is that it may be a more efficient means of promoting conservation than other investments utilities can undertake.

In the water sector, AMI comprises the equipment, communication, and data management systems for utilities to remotely collect customer water consumption data in near real-time. Importantly, AMI helps improve utility operations and grants utilities the ability to provide continuous and high-resolution information on water consumption to households and businesses. More specifically, AMI data can be utilized to promptly detect potential customer leaks, raise awareness of water conservation, and help customers develop their own strategies to save water.

Online customer usage portals can be an important part of the AMI infrastructure. When used effectively, AMI portals have the potential to benefit both utilities and customers by facilitating streamlined, near real-time communications. These communications include the delivery of behavioral interventions to promote water conservation.

The success of AMI portals depends heavily on the level of customer engagement with the portals. Often, registration for a new AMI portal and continuous usage of the portal require customers to overcome several psychological barriers and behavioral frictions. Currently, this continues to be a challenge—for most utilities we surveyed, only a minority of customers have signed up for the portal, and even less log in to the portal on a regular basis. Nevertheless, utilities have several instruments at hand, including the application of behavioral insights and experimentation, to make the portals more engaging for their customers.

This report maps utility experiences with AMI and presents how utilities can apply behaviorally-informed strategies to improve customer engagement and the efficacy of AMI portals. It is structured as follows.

- Section 2 provides an overview of the potential for saving water using AMI portals.
- Section 3 explains how behavioral research can help identify what works and reviews current evidence on the best practices in improving the efficacy of AMI portals.
- Section 4 presents the results of a national survey and 11 qualitative interviews with utility managers.
- Section 5 describes the findings of four field experiments that used behavioral insights to increase AMI portal uptake.
- Finally, Section 6 presents a synthesis of the findings and concluding recommendations.

02 The role of AMI in promoting residential water conservation

In this section, we discuss how AMI portals can help promote water conservation and the factors that likely influence the efficacy of AMI portals. We also review current evidence on the efficacy of AMI portals.

2.1 The case for AMI portals

There are several ways in which AMI portals can make existing AMI-based initiatives more effective and efficient in promoting water conservation. Many existing efforts to encourage water-saving behaviors can be made simpler and more efficient with AMI portals.

- First, the portals allow customers to enable leak alerts and high-usage alerts, ensuring that they are promptly[1] warned about any unusually high consumption. Customers can set alert thresholds that best fit their household contexts and receive notifications via their preferred channels (e.g., the portal itself, email, or text messages) when their water consumption exceeds certain pre-specified limits. By alerting customers in a timely manner when their increased water usage becomes close to incurring a higher unit rate, AMI portals can also help make price signals more transparent for customers.
- Second, AMI portals provide a platform for utilities to generate and better target communications using data collected from customers through the portals. As discussed below, the potential for saving water using AMI portals depends on several factors including individual and household characteristics. With household-specific data collected through AMI portals such as consumption patterns and equipment in use, utilities can provide water consumption feedback that is tailored and more relevant to customers to improve their engagement with AMI portals and subsequently increase their water savings. For example, AMI data can help target households with significant outdoor water use and promote optimal irrigation in these households over the summer.
- Third, AMI portals provide utilities with greater flexibility in delivering behavioral interventions by providing another touchpoint through which interventions can be delivered. AMI portals allow a utility to more easily monitor how customers interact with consumption data, communications, and other portal features. They also serve as a platform for utilities to regularly test, iterate, and identify interventions that are the most effective. Importantly, utilities can not only design and deliver interventions directly via AMI portals to promote water-saving behaviors, but also leverage AMI

[1] Notably, there is still some room for improvement in how quickly potential leaks are detected and notifications delivered. Many AMI-informed leak alert systems are triggered after 24 hours of continuous use. In addition, many utilities are not monitoring leaks 7 days per week. Therefore, weekend leaks may not be discovered until Monday or the next business day, potentially causing substantial loss of water.

data collected through the portals and deliver interventions using other channels (e.g., mailing home water reports) when it is more appropriate to do so.

- In addition, there are two important channels that are uniquely made possible by AMI portals. The portals empower customers to make better decisions by providing them with detailed near real-time data that is accessible at any time. Compared to the traditional method of mailing water usage reports to customers, AMI portals allow utilities to take full advantage of the high-frequency data collected via AMI by serving as a platform on which such valuable data can be analyzed and shared with customers in near real-time. As many water utilities in the US have tiered pricing systems (i.e., the marginal price differs depending on how much a customer has consumed), AMI portals (and the data they provide) can help customers understand where they are in the rate tiers so that they can better understand and react to price signals, ultimately enabling more rational consumption.
- Finally, AMI portals allow customers to engage with water consumption feedback and water-saving tips more interactively. Interesting and user-friendly features can be incorporated into the design and content of AMI portals to help drive customer engagement. Solutions that have proven effective in encouraging water conservation can also be continuously iterated and improved with innovative design elements before being delivered on AMI portals to promote water conservation more effectively. For example, gamified portals are increasingly popular in the water sector—the combination of the conventional uses of portals (e.g., providing consumption feedback and water-saving suggestions) and more interactive user experience (e.g., offering symbolic rewards such as points, badges, and likes and providing a platform for peer-to-peer competitions) has been implemented by some utilities, with early evidence obtained in Switzerland and Spain suggesting that the gamified approach is associated with greater customer engagement and increased water savings (Novak et al., 2018; Cominola et al., 2021).

2.2 Key factors determining the efficacy of AMI portals

While AMI portals can help promote water conservation through several ways as discussed above, their success is not a given and is likely determined by several factors.

Getting customers to register and engage with the portals and to open communications sent by utilities are important prerequisites for promoting water conservation via AMI portals. A review of 25 published studies conducted predominantly in Western countries showed that AMI portal sign-up rates tend to range between 30% and 45% (Liu & Mukheibir, 2018). Based on 11 interviews conducted as part of this work with U.S. utility managers (see Section 4.2), AMI portal registration rates ranged from 4% to 71%, with the majority of utilities leaning towards the lower end of this spectrum. Similarly, a customer survey as part of a smart meter trial in the UK finds that among those who received AMI web-based interventions delivered via a My SSE web portal by a UK energy provider SSE, only 50% were aware of the portal and a mere 9% used it, likely limiting the capacity of the interventions to have any impact (OFGEM, 2011). Importantly, a randomized trial finds that logging on to AMI portals is associated with statistically significant water savings over a 6-week period (Liu et al., 2017).

In addition, the adoption and use of portal features (e.g., leak alerts) can vary considerably depending on whether the features are default options. A simple way to encourage behavior change when customers are roughly indifferent between two options (e.g., signing up for leak alerts or continuing without them), or when they exhibit high levels of 'inertia', is to change the default option.[2] Rather than passively relying on customers to sign-up for portal features, utilities can inform customers that all portal users are automatically opted-in for useful features when they sign-up for AMI portals, while allowing for easy opt-out.[3] By changing the default option, utilities can shift a large proportion of disengaged customers who do not strongly care either way into the pool of customers with useful features at their disposal. While this may not ensure that they actively engage with the features to conserve water, customers would certainly not benefit if they were not signed up in the first place.

Individual and household characteristics of customers (e.g., socio-demographics, individual values, beliefs, and attitudes) are also important determinants of the success of AMI portals in promoting water conservation. Existing correlational evidence suggests that individuals who are younger, more educated, and earn higher income are more likely to engage with smart meters and achieve higher energy savings (OFGEM, 2011; Bugden and Stenman, 2019). Individuals with stronger pro-environmental values and attitudes are also more likely to engage with AMI and save more water. A randomized trial finds a treatment effect that is about 40% greater when comparing those with the strongest intent of preserving the environment to those with the weakest intent (Tiefenbeck et al., 2016). This result is corroborated by other non-experimental evidence that suggests a positive correlation between pro-environmental attitudes and AMI acceptance and engagement (see Bugden and Stenman, 2019 and Gimpel et al., 2020, for example).

In addition, several studies across different geographies found that perceived usefulness is a strong predictor of AMI adoption, including in Germany (Kranz and Picot, 2012), Korea (Park et al., 2014), and the US (Chen et al., 2017). On the other hand, increased privacy concerns have been found to be negatively correlated with the acceptance of smart meters, including in Korea (Park et al., 2014), the UK (Buchanan et al., 2016), and the US (Warkentin et al., 2017; Chen et al., 2017). These findings suggest that AMI portals are more likely to be successful if utilities can demonstrate their usefulness for customers while sufficiently addressing privacy concerns.

Moreover, previous field trials find that upon engaging with AMI, single and couple households conserve more water and energy compared to families (Nilsson et al., 2018a;

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[2] While not related to water conservation, this approach has enjoyed considerable success in increasing the rate of organ donation. Abadie and Gay (2006) demonstrate that 'presumed consent' to donate organs has a significant positive effect on donation rates, and Shepherd et al (2014) show that opt-out systems cause an increase in total transplants.

[3] It is important, however, to exercise caution when choosing default options and to consider context-specific legal requirements for an opt-out design. For example, while it may be plausible for utilities to use an opt-out design for email notifications, that might not be the case for text notifications as they may require opt-in documentations.

Nilsson et al., 2018b). One potential reason is that families are less able to adapt their daily routines (e.g., washing, cooking, and using energy- and water-consuming appliances) compared to households with fewer members.

The success of AMI portals is also likely influenced by how the portals and the communications are designed and targeted. As discussed above, individuals and households with certain characteristics have been found, to varying degrees, to be associated with AMI adoption and engagement. If relevant data are available (or can be collected), utilities could consider employing machine learning algorithms to predict which and when communications work best for different groups of people, thus improving the targeting of communications. For example, utilities could deploy an algorithm that utilizes AMI data to detect when a given household starts irrigating its outdoor plants in a given year. Utilities could then provide relevant and personalized water conservation tips to the irrigating households. Moreover, machine learning could also warn utilities when not to intervene—some households may, for instance, respond adversely to certain interventions.

The communication channels through which utilities can reach their customers (e.g., letter, text message, and e-mail) can also determine the extent to which AMI portals can help encourage water-saving behaviors. For example, even though an email is generally regarded as a more convenient delivery mode in this digital age, Dolan and Metcalfe (2013) find that printed copies of home energy reports are more effective than digital versions delivered via email. However, in some contexts, the low cost of e-mails and the possibility to include actionable hypertext links to e-mail messages might outweigh the higher engagement rate of printed materials. In addition, there is limited evidence on the effectiveness of app-based communications compared to alternative channels. For example, Geelen et al. (2019) find no significant reduction in energy consumption even though app users reported greater energy awareness and indicated to have made more investments and changes in their behavior. Their interview results also show that after an initial learning period, the app was used to monitor consumption levels rather than to lower them. However, more research on the effectiveness of in-app messages is needed before it can provide firm conclusions. Overall, the presented evidence suggests that utilities need to consider what may work best when communicating with different customers based on their specific contexts and circumstances.

2.3 Current evidence on the efficacy of AMI portals

Several studies have attempted to quantify the water savings potential associated with AMI portals. In this section, we review both correlational and experimental studies on the efficacy of AMI portals.

Correlational evidence

Based on recent meta-analyses and systematic reviews (Liu and Mukheibir, 2018; Torriti, 2020; Bertoldi, 2016; Battala-Bejerano et al., 2020), a credible range of water savings associated with AMI-based programs falls within a range of 2 to 10%.

A recent observational study finds that water consumption feedback informed by AMI data and facilitated by a SmartH2O digital platform is associated with substantial water savings of about 8% in the long term (Cominola et al., 2021). The online platform evaluated in the study provides several features informed by behavioral insights, including social comparisons, goal setting, interactive learning and sharing of water-saving tips, and gamified tasks that let users earn points, badges, and rewards. In addition, the study finds more frequent water-saving behaviors for customers who receive consumption feedback with hourly sampling frequency, suggesting that providing high-frequency feedback is a prerequisite for effective customer engagement.

> Based on recent meta-analyses and systematic reviews, a credible range of water savings associated with AMI-based programs falls within a range of 2 to 10%.

In addition, a study of 2,487 households in Northern Illinois finds that an AMI portal designed by C3 (a US company providing energy efficiency programs to utilities) that requires customers to set a personal savings goal can be effective in reducing residential electricity consumption (Harding & Hsiaw, 2014). While an average saving of 4% is reported, when customers set a realistic goal between 1-15% electricity savings, they achieve substantially higher savings (about 11% on average) compared to customers who set their savings goal to be 0% and higher than 15%, respectively.

While a growing body of studies suggests that AMI portals can promote residential water conservation when behaviorally informed strategies are used, there remain important knowledge gaps in the literature. Non-experimental studies can typically only provide correlational evidence rather than causal evidence. The correlational studies reviewed and discussed above also have other limitations, including small sample sizes and research designs that require people to volunteer or self-select into receiving the intervention (i.e., getting access to AMI portals). These limitations threaten both the internal validity (i.e., the identification of causal effects) and the external validity (i.e., the generalizability of the results) of the studies.

Experimental evidence

Overall, there is a limited number of experimental studies that study the causal effects of AMI portals on water consumption. There are, however, two randomized experiments that can offer valuable insights.

The first study is a randomized trial in Australia using an AMI portal My Home Our Water (MHOW). The experiment finds that following specific acts of logging on to the AMI portal, active users achieved significant savings of 4.2% relative to the control group in the short term (over a 6-week period), however, the engagement with the portal and associated water savings dropped after this period (Liu et al., 2017). The reductions in the observed effect indicate that the efficacy of AMI portals tends to drop after the novelty effect wears off. This underlines the importance of developing behavioral strategies that help preserve customer interest and engagement over time.

The second study is a randomized trial in Germany and Austria which finds that providing feedback via online portals developed as part of the Intelliekon project is as effective as via postal mail—customers on average reduced their energy consumption by about 5%, with the effect persisting over 11 months (Schleich et al., 2017). This result suggests that for customers who access the portal less frequently (e.g., once in a month), mailed home water reports might have comparable effects to AMI portals. It also highlights the importance of designing and implementing effective interventions to improve ongoing customer engagement with AMI portals if their full potential were to be realized.

As there is limited experimental evidence on the causal effects of AMI portals on residential water conservation, more rigorous evaluations need to be conducted to provide evidence that has high internal and external validity and support a conclusive assessment of the efficacy of AMI portals.

03 Using behavioral interventions to improve the uptake and efficacy of AMI portals

Changing behaviors can be difficult. Communications sent by utilities may be perceived by customers as instructions to alter their behaviors. As a result, customers may disengage completely—or even do the opposite of what they were encouraged to do. Behavioral experiments help us understand how the framing, content, and delivery of messages translate into positive behavior change. It offers valuable insights into how utilities can achieve desirable outcomes (e.g., getting customers to sign-up and engage with AMI portals) in a more consistent manner.

3.1 Using behavioral science, economics, and experimentation

It is essential to regularly evaluate interventions. The process allows utilities to learn from their successes and failures, iterate, and ultimately adopt the most effective solutions. A key aspect of the strategy is to conduct an evaluation over a long period if the long-term effectiveness of interventions is of interest. As it is often difficult to change people's habits, many behavioral interventions have diminishing impacts over time. The key challenge is to identify the right portfolio of interventions for the problems that utilities wish to solve.

The design and evaluation of interventions are critical in developing an effective strategy for addressing the challenges. One rigorous way of evaluating interventions is to conduct a behavioral field experiment, which is essentially a randomized controlled trial conducted in a natural setting (as opposed to in a lab), to measure changes in human behavior. This methodology can, for instance, be used to test the effectiveness of behaviorally framed messages to encourage AMI portal sign-ups. Typically, such an experiment is conducted by randomly assigning customers to 'treatment' groups (which receive newly designed messages) and a 'control' group (where no change is made). Given a sufficiently large customer base included in the experiment, this process produces a sample that is representative of the utility's customers and ensures that each group is statistically identical except for the interventions they receive. Utilities can then compare outcomes of interest to identify and evaluate the causal effects of interventions relative to the control group and each other.

3.2 Current evidence on behavioral interventions related to AMI portals

A growing body of evidence suggests that using behaviorally informed strategies can improve the efficacy of AMI portals. Indeed, a pressing issue many utilities face is that most customers either never log in to AMI portals or lose interest after initial use, which essentially renders the portals ineffective. Given the under-utilized potential of AMI portals, it is important to develop behavioral interventions that can maintain customer interests in the platforms. The sub-sections below discuss behavioral insights that can be applied to improve the efficacy of AMI portals—both in terms of increasing the uptake of, and engagement with, AMI portals and promoting behavior change that will lead to reduced water consumption.

> A pressing issue many utilities face is that most customers either never log in to AMI portals or lose interest after initial use, which essentially renders the portals ineffective. Given the under-utilized potential of AMI portals, it is important to develop behavioral interventions that can maintain customer interests in the platforms.

Incentives

Several incentive-based interventions have been used to encourage AMI uptake and engagement. Financial incentives, in particular, have been found effective. List et al. (2018) find that among British Gas customers who had not adopted smart meters in 2013, those who received small financial incentives (£5 and £10, which corresponds to approximately \$6.5 and \$13) were about 30% more likely to book an appointment for installation and to actually have the smart meter installed than their counterparts who did not receive any incentive. Similarly, a randomized controlled trial conducted by The Behavioralist in collaboration with Northumbrian Water found that sending direct mailers that offered cash rewards for completing an online water diagnostic was more effective than moral and social appeals. Interestingly, the size of the incentive matters only marginally as the £10 (\$13) and the £15 (\$19.5) incentives are found to be roughly as effective. The positive effect of financial incentives on portal uptake was replicated in another trial conducted by The Behavioralist that included WaterSmart customers in Glendale, California. Financial incentives intended to improve the take-up of, and engagement with, AMI portals can also include lotteries, such as a quarterly prize drawing with iPad giveaways by Madison Water Utility (Liu and Mukheibir, 2018).

> Sending direct mailers that offered cash rewards for completing an online water diagnostic was more effective than moral and social appeals.

Providing households with environmental incentives is another strategy that has been studied within the context of energy and water conservation. A pilot study in Sweden programmed AMI panels to either inform consumers about how much money they saved or how much emissions they reduced by shifting their consumption to an off-peak period and find that financial signals (i.e., money saved) are more effective than environmental signals (Nilsson et al., 2018b).

Finally, existing evidence suggests that AMI portals can boost customer engagement by offering symbolic rewards such as points, badges, likes, and leaderboards (Alskaif et al., 2018; Moreno-Munoz et al., 2016). Galli et al. (2015) describe the gamified version of an AMI portal under the EU-funded SmartH2O project, which enables customers to collect points and badges and to redeem rewards to improve their water management and conservation. Erickson et al. (2012) report that 48% of the Dubuque water portal users engaged with the portal's gamified elements (i.e., the weekly games). Further, a pilot study in Switzerland finds that engagement with the gamified version of a portal is substantially higher than engagement with the basic version (Novak et al., 2018). Another pilot study finds an average water saving of 10% and 20% for gamified portal adopters in Switzerland and Spain respectively (Rizzoli et al., 2018). More encouragingly, a longitudinal study finds that those who have access to a gamified portal achieve substantial water savings not only in the short term, but also in the long term (two years after the start of the treatment) (Cominola et al., 2021).

Reminders

Sending reminders to customers has been previously shown to improve both the uptake of, and continuous engagement with, water conservation technologies. For instance, a randomized controlled trial conducted by The Behavioralist in collaboration with WaterSmart Software finds that sending reminders significantly improves customer portal usage. Another trial by The Behavioralist and Northumbrian Water finds that email reminders targeted at customers who did not complete water diagnostics on an online platform successfully increased the completion rates by 160% (from 1.9% to 4.9%)on average.

Overall, there is limited evidence on the direct effect of reminders on water consumption. However, with the increasing connectedness and proliferation of technology, it is becoming clear that AMI portals can effectively leverage push and pull notifications to maintain customer engagement with the portal and promote water-saving efforts. Notifications can be used to inform customers about events involving leaks and the beginning of a peak-usage period. They can also warn individuals when certain consumption thresholds have been reached. To identify the most effective approaches in reminding customers to sign-up and engage, utilities and their partners can design different versions of reminders and track engagement (e.g., via clicks and email open rates) as exemplified by WaterSmart's approach (Liu and Mukheibir, 2018).

Feedback provision

Providing customers information about their water usage on a regular and near real-time basis can help them understand how their actions are directly linked to the amount of water consumed. Developing such understanding may, in turn, increase customers' motivation and perceived ability to save water.

An important design element in feedback provision via AMI portals is the choice of units in which feedback is presented. Providing feedback in the units of gallons or liters is more relatable to customers and thus has a stronger potential to promote water conservation. A customer survey in Australia finds that customers prefer feedback presented in the form of volumes per event (e.g., liters per shower), per day (e.g., liters per day of toilet use), and per week (e.g., liters per week of outdoor use), relative to feedback capturing frequency (e.g., buckets of leak per day) and duration (e.g., minutes per an average shower) (Liu et al., 2015). Similarly, in the energy sector, units such as kWh and CCF tend to be seen by customers as hard to understand, confusing, and of little relevance (Rettie et al., 2014).

> Customers prefer receiving disaggregated feedback on AMI portals so that they can easily identify which appliances or activities consume the most energy or water.

In addition, qualitative interviews show that customers prefer receiving disaggregated feedback on AMI portals so that they can easily identify which appliances or activities consume the most energy or water (Nilsson et al., 2018a). While not provided directly through a portal, a randomized controlled trial in Australia found that tailored and disaggregated feedback delivered via postcards helped achieve reduced water consumption in the long run (Fielding et al., 2012). These findings suggest that AMI portals that provide disaggregated feedback in customers' preferred units are more likely to have greater customer engagement and deliver higher water savings.

Personalization

Providing consumption feedback or saving tips alone may not be sufficient to reduce water consumption (Schultz et al., 2014; Geelen et al., 2019). For instance, generic water-saving tips may be deemed irrelevant to the situation of a given household and therefore ineffective. Leveraging household-specific data such as consumption patterns and equipment in use can help make feedback and water-saving tips more relevant to customers and improve their engagement with AMI portals.

Two randomized trials found that home water reports that provide personalized water-saving recommendations (along with social comparisons and financial incentives) reduced consumption by about 5% on average (Brent et al., 2015). The recommendations were tailored to the specific features and appliances used by households. For example, those without an outdoor area were not given a recommendation regarding irrigation, and those with a low-flow toilet were not informed about the rebates for high-efficiency toilets. Similarly, Fielding et al. (2012) find that providing households with a breakdown of water consumption per appliance and tips on how to reduce water use for the most consuming appliances produce long-term reductions in water use as compared to providing generic water-saving tips.

Simplification

While the provision of detailed and disaggregated feedback is generally helpful, more information is not always better. A study found that visual complexity and prototypicality (how closely a category member resembles the category prototype) of websites significantly influence users' initial impressions—websites that are less visually complex and more prototypical are perceived as more appealing (Tuch et. al., 2012). Care must therefore be taken to ensure that AMI portals are not overloaded with information to the extent of overwhelming users who are seeking actionable feedback.

> The overall user experience of registering for and using the portal should be made as hassle-free and easy to use as possible.

To improve the user experience of AMI portals, a recent meta-analysis recommends designs that are user-friendly and intuitive (Hartley et. al., 2021). In addition, Sønderlund et. al. (2016) found that feedback in the form of easy-to-read consumption graphs and statistics is highly valued by consumers. In general, the overall user experience of registering for and using the portal should be made as hassle-free and easy to use as possible to help customers overcome behavioral frictions in signing up and engaging with the portal.

Loss framing

It is well established in behavioral science and economics that people dislike losing more than they like winning (Kahneman and Tversky, 1984). For example, if a customer starts a day with $100 and ends up with $90, she will be considerably less happy than if she started with $80 and ended up with $90, despite having the same amount of money at the end of the day. This phenomenon of loss aversion suggests that customer decision-making is particularly sensitive to the way messages are framed. Customers are more likely to act if they were told that they would lose money by failing to reduce water consumption than if they were informed that they could save money by cutting water use.

> Customers are more likely to act if they were told that they would lose money by failing to reduce water consumption than if they were informed that they could save money by cutting water use.

A large-scale randomized controlled trial conducted by Hahn et al. (2016) in partnership with San Antonio Water System (SAWS) analyzes the impact of offering rebates for the uptake of drought-resistant plants. One of the findings from the study is that using a loss-framed message increases the number of requests for the rebate program. This result highlights how small changes in the framing of communications can produce large shifts in efficient technology adoption behavior. Including loss-framed messages in communications sent to customers is therefore a potentially effective strategy to increase customer sign-ups and engagement with AMI portals and to promote water-saving behaviors.

Social comparison

Individuals are strongly influenced by the expectations and actions of others, including in the domain of resource conservation (Allcott, 2011; Farrow et al., 2017). Informing customers about how much water an average household in the area consumes can help establish social expectations and motivate high-consuming households to reduce their consumption to meet the social norm.

A number of trials found that adding a social comparison element to water bills or customer postcards reduces water consumption by approximately 5% (Brent et al., 2015; Datta et al., 2015; Ferraro and Price, 2013). Importantly, social comparison is found to have the strongest effect in high-consuming households (Datta et al., 2015), when households have strong links to other households in the area (i.e., the identification with the social comparison group was high) (De Dominics et al., 2019), when individuals' personal norms to conserve water are low (Schultz et al., 2014), and when individuals are asked to make an explicit commitment to reduce their consumption upon receiving the social comparison message (Jaeger and Schultz, 2017).

Interestingly, Schultz et al. (2014) find that social comparison messages produce a greater effect when delivered by post as compared to via an AMI portal. The reason is that a lower number of individuals access the portal compared to those who received and opened the mail. This finding further emphasizes the importance of designing AMI portals that require minimal effort to access and engage with.

While social comparisons have been found to help reduce water consumption, more research is needed on their welfare effects (i.e., their social costs and benefits). Nauges and Whittington (2018) compare the social benefits and costs of a social comparison program to those resulting from a price increase that yields an equivalent reduction in water consumption. They find that on average, the net benefits of increasing water rate exceed the net benefits from social comparison programs in industrialized countries. Their results suggest that rather than uncritically favoring social comparisons, utilities need to rigorously evaluate their interventions and conduct cost-benefit analysis to ensure that they are maximizing consumer welfare.

Goal setting and commitment

Enabling households to set realistic conservation goals and commit to them have been found to motivate reduced water and energy consumption (Abrahamse et al., 2006; Vivek et al., 2021), although the quality and number of studies are relatively low (Andor and Fels, 2018). Several factors determine whether goal setting can produce significant savings. First, the goal must be realistic. In a study focusing on energy consumption, Harding and Hsiaw (2014) find that when people set a realistic goal between 0-15% savings, they achieve higher savings (11%) compared to the average sample (4%) in which the set goals ranged between 0-50%.

> AMI portals can effectively promote water conservation by allowing customers to set and commit to goals that are realistic, concrete, and public.

Second, if individuals are prompted to develop a specific plan to achieve their goal, the chances of attaining the goal are higher. For instance, a randomized controlled trial in a low-resource setting found that a plan-making intervention reduced water consumption by 3.4-5.6% (Datta et al., 2015). Finally, if individuals commit to achieving their goal publicly (e.g., on a website that everybody can access or with a group of friends), they are more likely to succeed (Epton et al., 2017). While AMI portals can potentially help promote water conservation by allowing customers to set and commit to personal targets, the strategy is more likely to be effective if the portals also encourage customers to set goals that are realistic, concrete, and public.

Summary

In summary, there is a wide range of ways utilities can tap into behavioral science to make their AMI portals more efficient based on the findings discussed above. When developing a behaviorally-informed strategy, adopting a “test-and-learn” approach is essential. As the effectiveness of different interventions can be highly context-specific, a utility might need to test several strategies and their combinations, ideally by using randomized controlled trials (or A/B testing for communications and portal features) as the main evaluation method to identify what works best in different contexts. By building on the trial findings, an agency can take a systematic and evidence-based approach in using behavioral interventions to improve the uptake and efficacy of AMI portals.

04 Utility experiences with AMI roll-out: Results of a national survey and qualitative interviews

4.1 National survey

In collaboration with AWWA, The Behavioralist developed a quantitative survey to better understand utilities' experiences with the AMI roll-out. The purpose of the survey, as presented to the respondents, was to "*understand your company's experiences with rolling out AMI*". The survey had three main parts to map experiences with AMI roll-out, using AMI customer portal, and using AMI data to help customers save water.[4]

The survey was administered through Qualtrics from August 26 to September 27, 2021. We distributed the survey using the AWWA general mailing list and collected more than 500 responses in total.[5] Data cleaning and analysis were conducted using the statistical software Stata.

4.1.1 Summary of the main findings

We found through the survey that utilities are overwhelmingly confident that AMI provides benefits to both their customers and themselves. The enthusiasm is understandable, given that AMI greatly extends the possibilities in obtaining precise consumption data, deploying highly targeted interventions to consumers, and informing utility operations and decisions.

> Utilities are overwhelmingly confident that AMI provides benefits to both their customers and themselves.

While over two-thirds of the surveyed utilities are rolling out AMI in full, providing customers with access to AMI portals takes longer. At the time of the survey, slightly over 40% of the utilities provide their customers with portal access, while another third is still working to provide portal access in the future. With numerous portal providers and features available, utilities are understandably taking more time to explore and pilot what works best in their unique case.

Finally, the survey shows that the majority of surveyed utilities are already using AMI data to a large extent to inform their operations. This might include utilizing AMI data to identify

[4] While the survey was originally intended to be more in-depth, survey programming errors unfortunately disrupted data collection and prevented us from obtaining data related to AMI portal sign-ups and engagement.

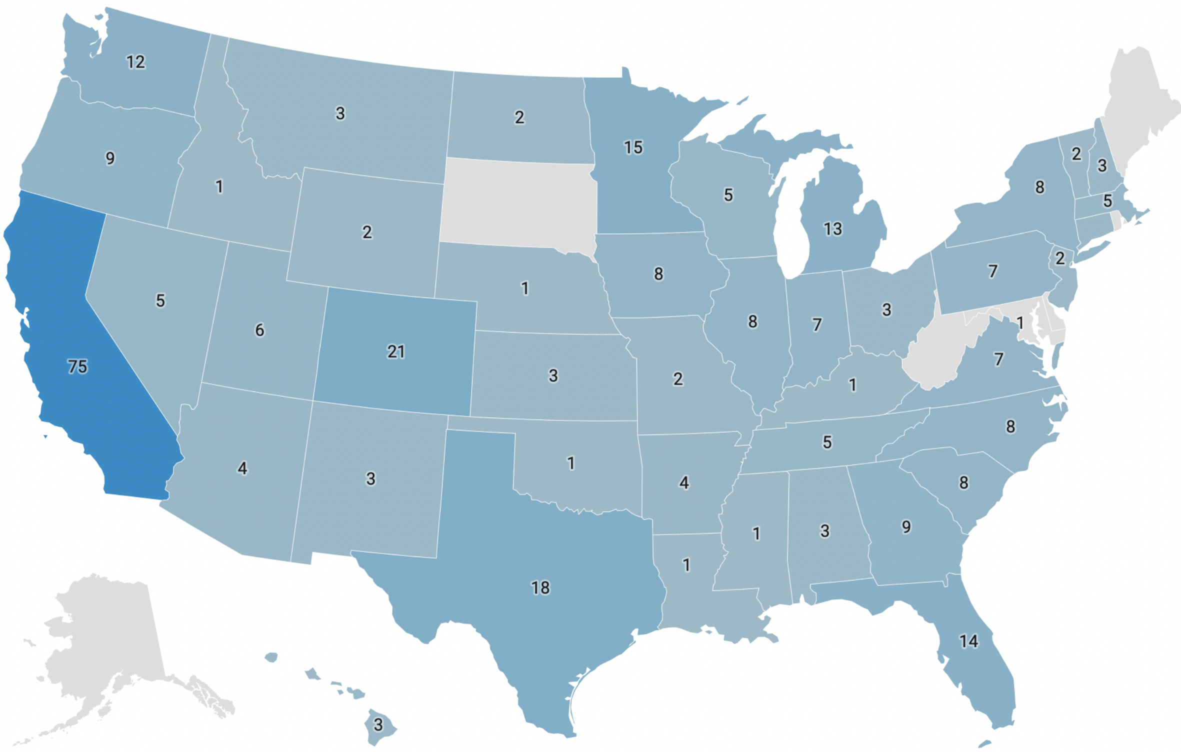
[5] After duplicated and invalid responses were dropped, we have a sample size of 322 representatives (from 322 utilities).

potential leaks and alert customers, targeting over-consuming households, and providing tailored water-saving advice to residents.

4.1.2 Sample characteristics

After duplicated and invalid responses were dropped, we have a sample size of 322 representatives (from 322 utilities) from 44 states across the US.[6] Figure 1 shows the distribution of where the utilities are located. Water utilities in California constitute the largest share of the utilities in the sample (about 23%), followed by Colorado, Texas, Minnesota, and Florida.

Figure 1. Distribution of utilities that participated in the survey



Visualization created with Datawrapper

Most of the utilities surveyed (about 91%) are publicly owned. Approximately 59% are departments of a municipality and 34% are standalone agencies. In terms of the type of services provided, all utilities cover water, while 63% and 33% also cover wastewater and stormwater respectively.

[6] Details on the process of data cleaning can be found in the Appendix.

Figure A1 (in the Appendix) provides information on the consumer segments served by utilities. Most utilities serve individual households (98%) and multi-family residences (94%). As many as 76% of the surveyed utilities also serve commercial customers.

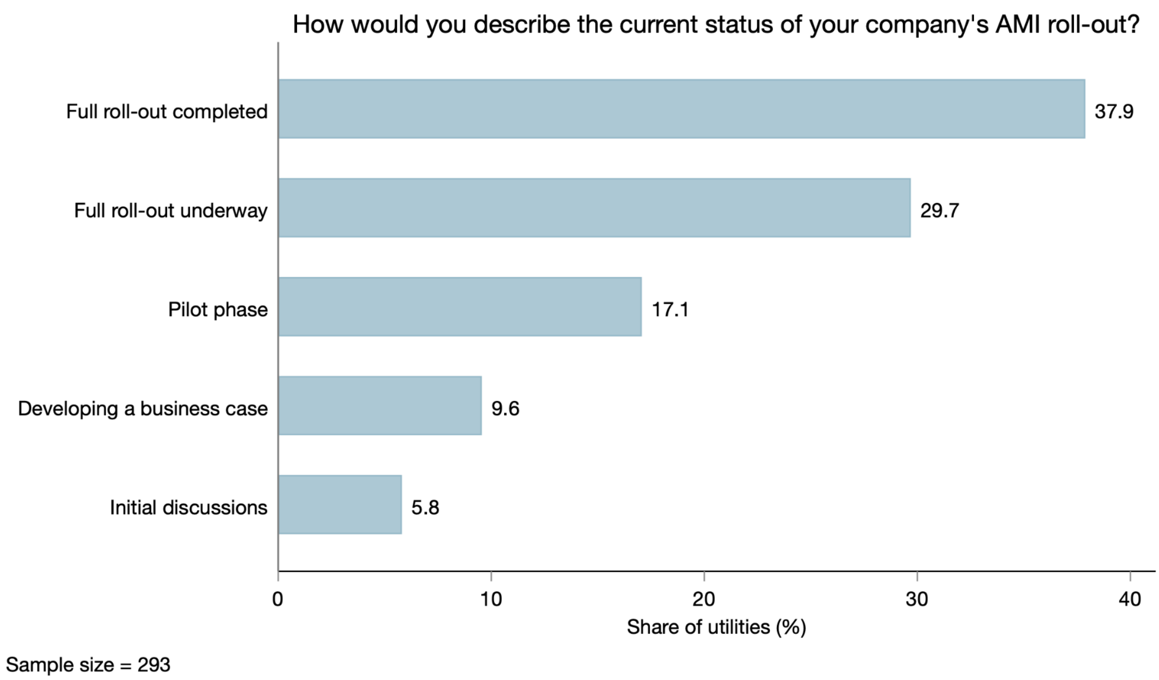
Figure A2 (in the Appendix) shows the breakdown of the number of connections for the utilities. About half of the utilities (46%) have 10,001 to 100,000 total connections, followed by 3,301 to 10,000 connections (24%). Only about 14% of the utilities have more than 100,000 connections.

Most of the respondents who took the survey on behalf of their utilities hold executive or management roles (about 62%), as shown in Figure A3 (in the Appendix).[7]

4.1.3 Status of AMI roll-out

Most of the surveyed utilities have already completed the AMI roll-out phase (38%). Almost a third of the utilities are currently rolling AMI on a full scale (30%), whereas the remaining third are in an earlier stage of AMI roll-out. Figure 2 displays the current roll-out status in detail.

Figure 2. AMI roll-out status



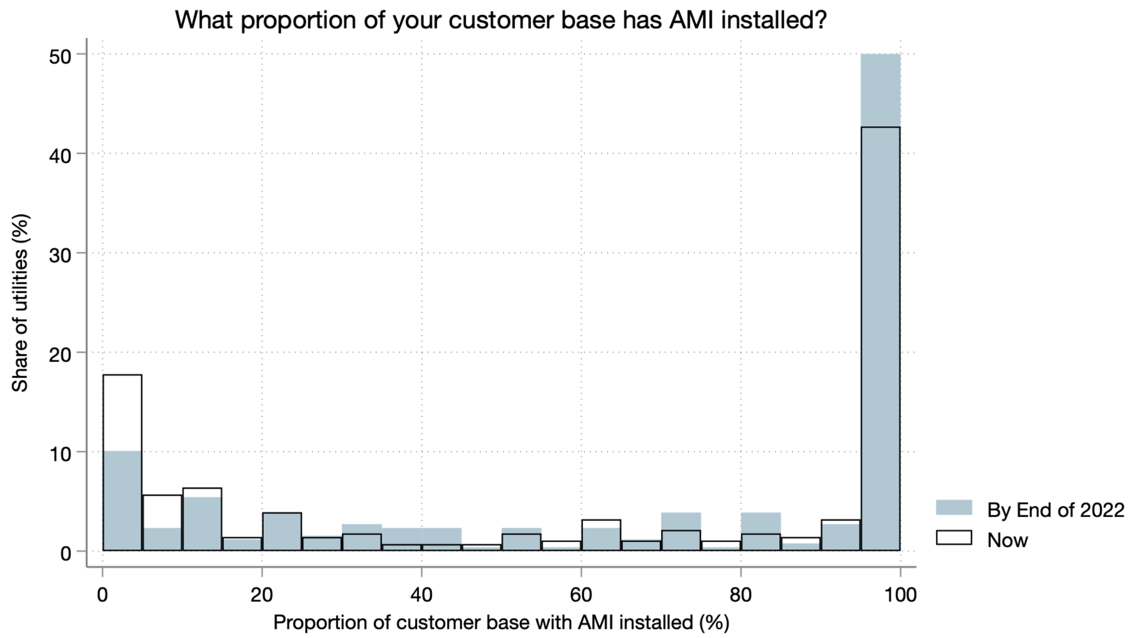
[7] In the process of cleaning duplicated responses, we also prioritized responses provided by those who hold executive or management roles by dropping the responses from those who hold junior roles for each duplicated utility.

Correspondingly with the previous finding, over 40% of the surveyed utilities reported that almost all of their customers have AMI installed. In terms of the next-year outlook, half of the utilities expected more than 95% of their customer base to be equipped by AMI by the end of 2022. In contrast, approximately 10% of the utilities expect that they will not start with rolling out AMI by the stated period (see Figure 3).

4.1.4 Perceived benefits of AMI

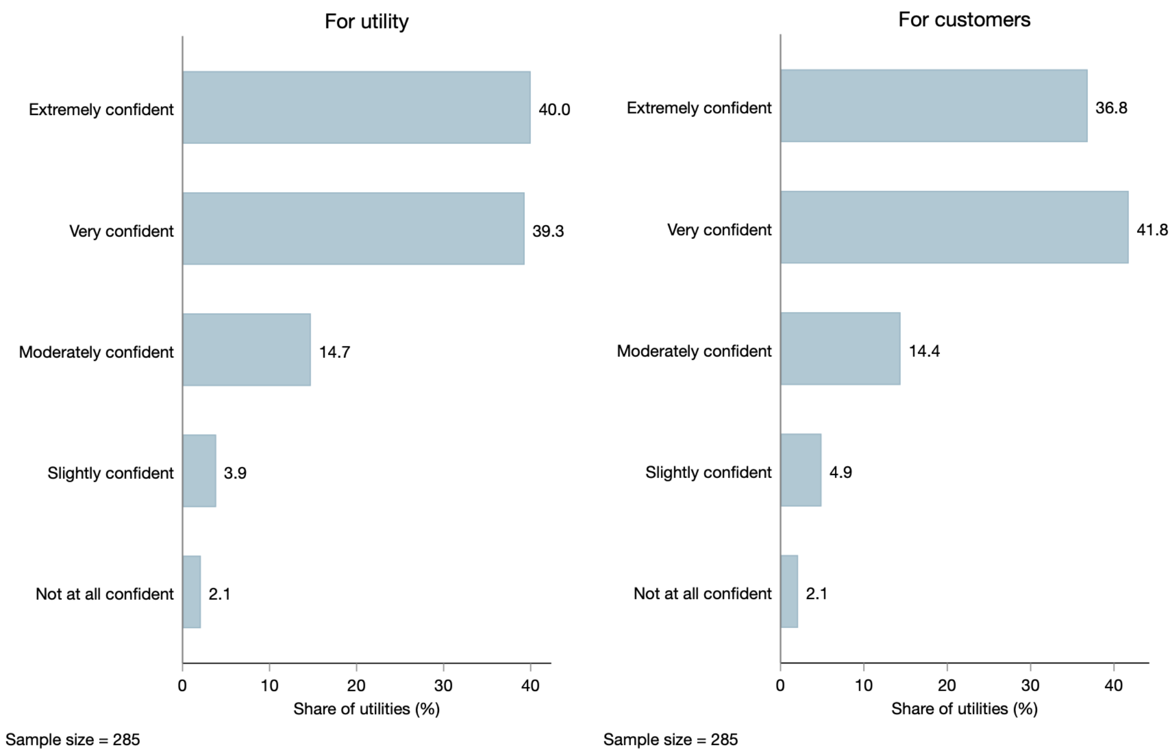
Most utilities are strongly confident about the benefits of AMI for both themselves and their customers. As shown in Figure 4, 79% of the surveyed utilities are either very confident or extremely confident that AMI will be beneficial to the utility. In terms of customer benefits, the perceptions are almost identical: 79% of the utilities are either extremely confident or very confident about the benefits of AMI for their customers.

Figure 3. The proportion of AMI-installed customers



Sample size (now) = 281; Sample size (by end of 2022) = 258

Figure 4. Benefits of AMI for utilities and customers



4.1.5 Usage of AMI portals and AMI data

While the majority of utilities are rolling out AMI in full, providing customers with access to portals takes considerably longer. At the time of the survey, approximately 43% of utilities provided their customers with access to an AMI portal. Another third of the utilities (33%) plan to provide customers with portal access in the future (see Figure 5).

Most utilities that currently provide access to portals rely on additional channels to present AMI data to customers. For example, approximately 68% of the utilities that offer portal access also provide a smartphone application to view consumption data. Further, about 27% of surveyed utilities still send paper reports to their customers. Figure 6 shows the popular channels in more detail.

As seen in Figure 7, utilities that do not currently offer access to an AMI portal rely either on paper reports (37%) or do not share AMI data with customers at all (41%). Some also include AMI data in customer bills or share them with customers via in-home displays.

Figure 5. Access to AMI portal

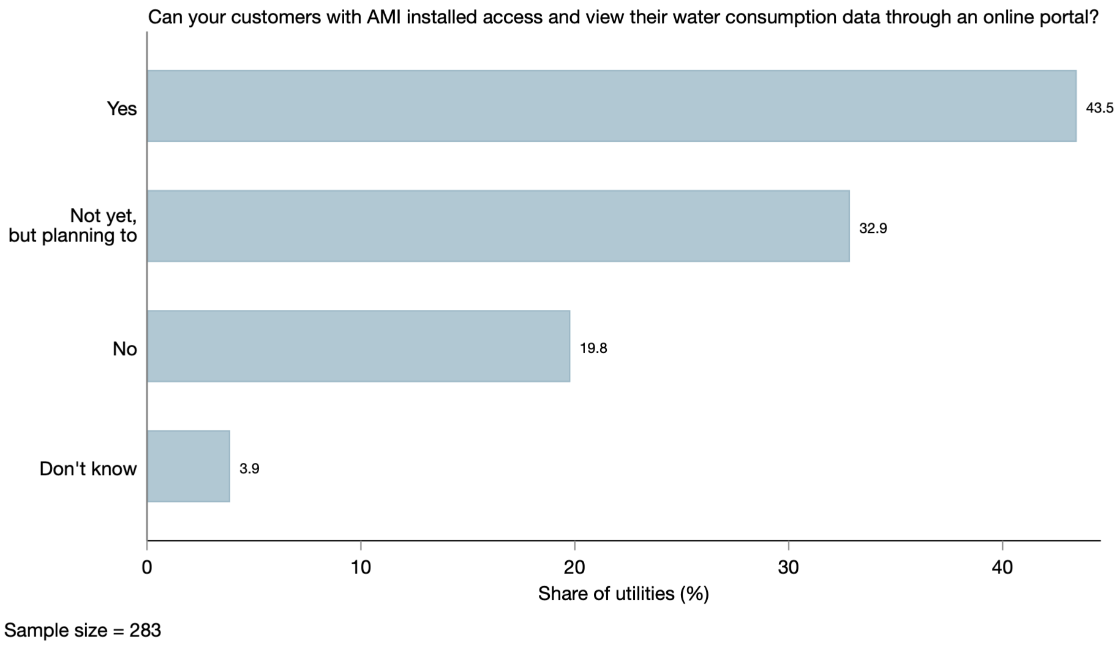


Figure 6. Other channels of accessing and viewing consumption data for utilities with AMI portals

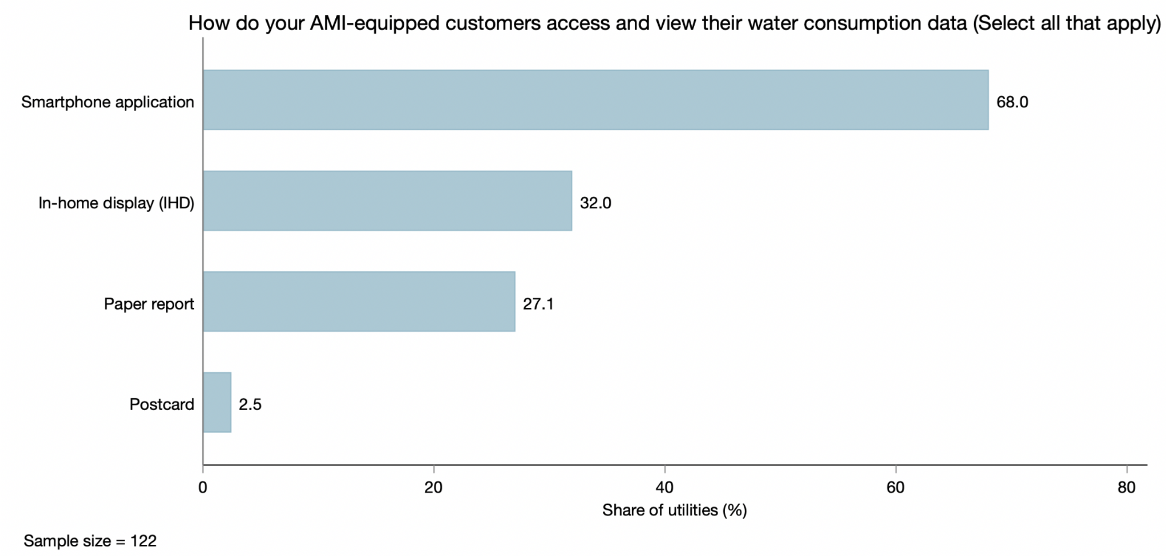
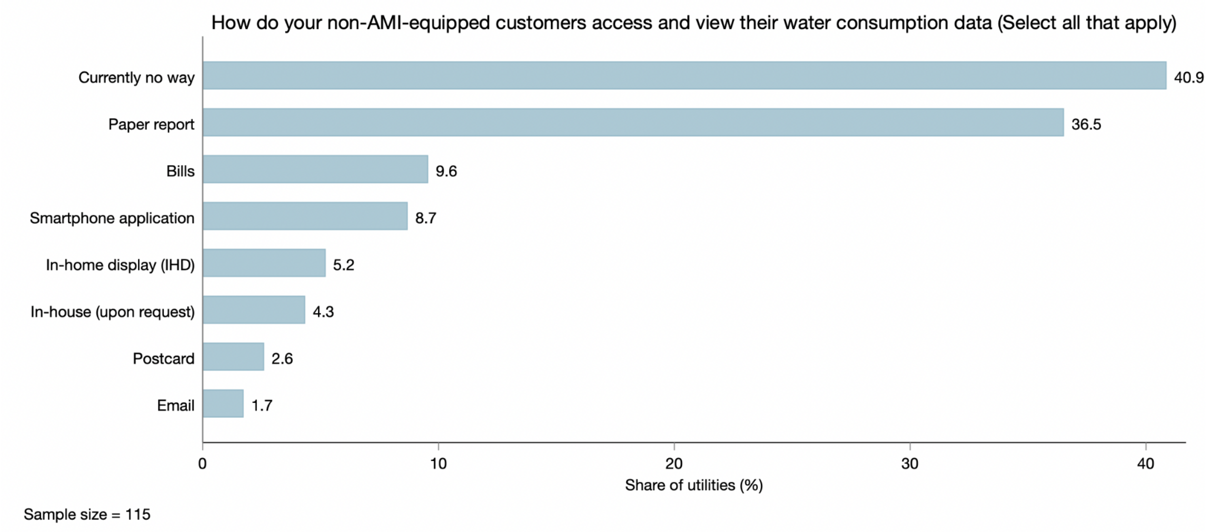
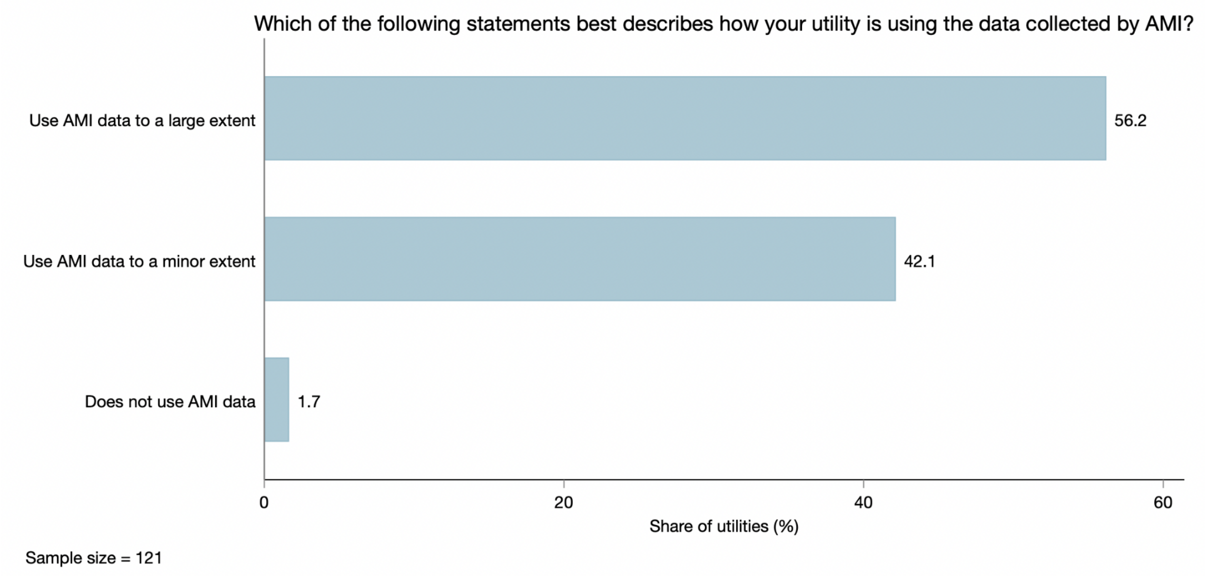


Figure 7. Channels of accessing and viewing consumption data for utilities without AMI portals



When asked about the extent to which utilities leverage their AMI data to inform their operations, most agencies report using the data to a large extent. An additional 42% utilize AMI data to a limited extent, via a limited number of employees who can access and process the data (see Figure 8).[8]

Figure 8. How AMI data is being used

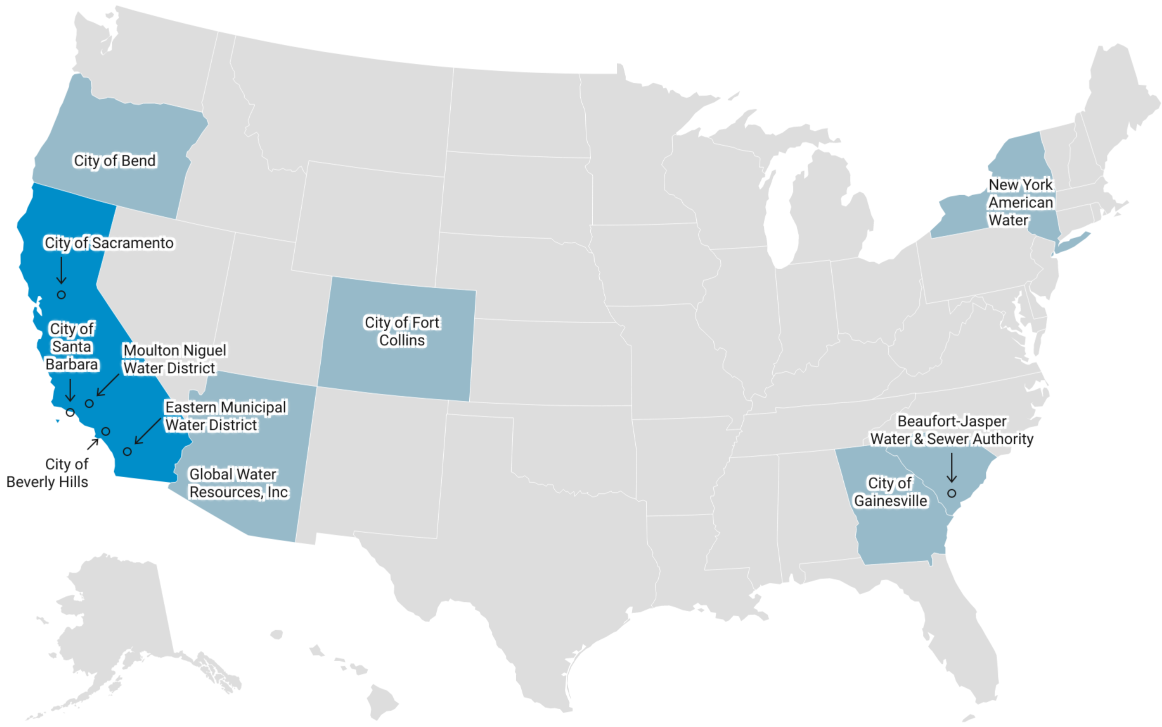


[8] We defined 'to a large extent' in the survey as "Most employees can directly access the AMI data (e.g., through a dashboard that provides basic analytics and reporting), including line staff. The data are systematically used to inform the work of employees or the utility's operations.", and 'to a minor extent' as "Some employees have access to the data and occasionally produce analyses and reports to inform the work of employees or the utility's operations."

4.2 Qualitative interviews

To obtain a more in-depth perspective into utility experiences with AMI roll-out, we conducted 11 qualitative interviews with managers working in water utilities across the United States. All interviewees were recruited using the AWWA contact network. The purpose of the interview as presented to the participants was to "*learn about your experiences with deploying AMI and identify lessons learned that will inform the best practice in the field*". All interviews were conducted between July and September 2021. Figure 9 shows locations of the interviewed utilities.

Figure 9. Distribution of utilities that participated in the interviews



The interviews were semi-structured around three areas: encouraging customers to sign-up to AMI portals, maintaining continuous user engagement with AMI portals, and using AMI data to help consumers save water. During each interview, the researcher worked with the interviewee to explore all three topics and identify key learning that could help other utilities in increasing customer engagement and AMI efficiency.

The key findings obtained in the interviews were synthesized into a general summary (see Section 4.2.1) and individual case studies per utility (see Section 4.2.2).

4.2.1 Summary of the main findings

In terms of increasing portal sign-ups, perhaps the most important lesson is to make the sign-up process simple for customers. For example, utilities that have consolidated their billing portals with AMI portals benefit from dramatically higher AMI portal registration rates compared to utilities with two separate portals. One of the reasons is that customers can view their AMI data by accessing the portal they are already used to and using the same login credentials to access both their billing and consumption information. Similarly, defaulting customers into helpful features such as leak alerts proved effective in most cases, as did helping customers understand the appropriate water consumption for their house through automatic water budgets and sharing consumption averages for similarly sized households in the area. Finally, keeping customer communications short and avoiding jargon (e.g., "AMI") can generate higher customer engagement with communicated information.

> Utilities that have consolidated their billing portals with AMI portals benefit from dramatically higher AMI portal registration rates compared to utilities with two separate portals.

The second key finding is that mass communications promoting AMI portals are rarely as effective as desired. Instead, utility managers reported that outreach in moments when customers tend to be most sensitive about their water use is much more successful in driving AMI portal registrations. Examples of such moments include the times when customers are experiencing a potential leak, paying a water bill, calling a utility customer service representative, or facing an upcoming drought in the area.

Third, investing in the development of community champions who spread positive words about AMI can go a long way in portal uptake. Presenting the benefits of AMI to relevant stakeholders (e.g., local council officials) through open house events and Q&A sessions can help create mutual trust and generate interest in the new technology. It can also motivate consumers to help spread the word about the portal to their friends and family members.

The fourth finding is that being able to clearly explain the benefits of AMI to customers is an essential prerequisite for increasing AMI uptake. Whereas some utilities focus on highlighting the savings potential of AMI to their customers (e.g., AMI can identify an early leak or send a warning if a customer is about to move to a higher pricing tier), others offer and communicate additional bonuses for registered customers (e.g., by signing up for an AMI portal, one becomes eligible for additional conservation grant programs). Importantly, different customer types seem to be responsive to different benefits. For example, whereas commercial customers are more attracted to the prospect of continuously saving water and money, residential customers look to avoid leaks and manage their water consumption as effortlessly as possible.

Fifth, establishing AMI as an organizational priority in the utility can help the company employees better promote AMI to customers. This can be done through multiple ways. First, add current portal sign-up rates to regular management meeting agenda. Second, explain the value of AMI to customer representatives so that they can better promote it. Last, change customer call checklists or training to gauge customer's interest in AMI.

Finally, the interviews suggest that it is essential to adopt a “test and learn” approach when designing interventions to increase AMI uptake. Utilities should experiment with different options of communication strategies, learn, and identify what works best. Similarly, piloting different AMI portal providers can help the utility understand which features are most sought after by its customers. This can be complemented by customer surveys and qualitative interviews to better understand customer experiences and needs associated with using the portal.

4.2.2 Individual case studies

4.2.2.1 Incentivizing customer service representatives to promote portal sign-ups (Beaufort Jasper Water and Sewer Authority, South Carolina)

Utility profile
Service area: **Beaufort and Jasper Counties, South Carolina** Service area connections: **60,000** Percent residential: **93%** Link to service area website: Beaufort Jasper Water and Sewer Authority (bjwsa.org) AMI roll-out stage: **roll-out completed in 2016** Percentage of AMI coverage: **100%** Year of AMI portal launch: **2017** Link to AMI portal: EyeOnWater: Making Water Visible.™ Percentage of customers registered in the portal: **20%**

The challenge: In 2019, BJWSA served over 65,000 residential customers. However, only around 15% of its customer base has signed up for the *Eye on Water* AMI portal. The portal sign-ups were stagnating and – given that only about a third of customers have provided their email address to BJWSA – electronic outreach to non-registered customers was difficult.

Approach: BJWSA set an organizational priority to achieve 20% portal sign-ups by June 2020. To achieve the goal, the company implemented a number of strategies. First, BJWSA promised its customer service representatives to enter them in a $50 Amazon voucher/cash reward raffle if the company achieved 18% portal registrations by June 2020 (see Figure 10). Second, to expand the email database, BJWSA changed the checklist used by Customer Service representatives. Any time the representatives were talking to a customer, they either asked for an email or verified the existing email address. Further, additional calls were made to customers who had not yet provided an email address.

The result: By deploying the outlined strategy, BJWSA achieved the 20% portal registrations goal by June 2020. It also doubled its customer email database from approximately 17,000 emails in 2019 to 36,000 emails in June 2021. The large email database makes their portal outreach methods much more effective. For example, a significant spike in portal sign-ups occurs every time BJWSA sends out one of its quarterly newsletters.

Lessons learned: Small changes in the routine of customer service representatives such as providing small financial incentives and adding a prompt to the call checklist can go a long way in improving portal uptake.

Figure 10. Internal flyer for BJWSA employees to encourage them to promote AMI portal to customers

4.2.2.2 Conservation Scorecard - a tool that leverages AMI data to help consumers save water (Eastern Municipal Water District, California)

Utility profile
Service area: **558-square miles in western Riverside County, California** Service area connections: **162,500** Percent residential: **80%** Link to service area website: www.emwd.org AMI roll-out stage: **roll-out completed in 2019** Percentage of AMI coverage: **100%** Year of AMI portal launch: **2020** (not yet fully available to customers) Link to AMI portal: N/A

The challenge: AMI portals and water bills can effectively prompt consumers to save water. However, the presented information often tends to be lengthy and complex which makes consumers less motivated to engage with their consumption data.

Approach: EMWD provides water budgets to all residential properties in its service area. This is based on the number of people living within the household, irrigated landscaped area, the age of the home (newer homes have stricter standards), and any current water supply restrictions. As such, every customer in EMWD's service area has a unique water budget that is designed to promote water use efficiency. The budgets have two tiers, as well as a third and fourth tier for use that exceeds the monthly budget and carries financial disincentives through progressively higher price points.

The result: The water budget now forms a central element of a two pager called the Conservation Scorecard (see Figure 11) which is sent to all registered households on a regular basis. The scorecard consists of several elements. First, it displays consumers' water consumption in the past weeks and compares it against their assigned water budget. Second, the Conservation Scorecard also provides information about available rebate programs, season-based water conservation tips, and events.

Lessons learned: The key learning in this project was to make things simple: the utility has engaged external consultants to help them design a card that is simple to understand, avoids jargon and is attractive to look at. EMWD is proud of its customer-focused efforts, including its conservation scorecards, leak notifications, and much more. The result is a customer base that has all the tools necessary to better understand their water use habits to become more efficient.

Figure 11. Conservation Scorecard

My Conservation Scorecard

Generated on 05/20/2021 at 09:04:15 PDT

Account:
Address:

Scorecard Date:	**05/20/2021**
Number of Occupants:	**3**
Irrigable Sqft:	**3390**

EMWD bills in either billing units or Acre-Feet.
1 Billing Unit = 748 Gallons.
1 Acre-Foot = 325851 Gallons.
Data contained within this report is for informational purposes only and is only to be used as a guideline. The budgets are only estimates as of the current date of this report. Actual budgets are determined using several factors, one of which is Evapotranspiration (ET) which will change daily throughout the month.

Water Usage Summary

Most Recent 12 Months [Gallons per Month]	Prior 12 Months [Gallons per Month]
15,125	11,892

Conservation Programs

Smart Controller Direct Install Program (Residential)

EMWD is offering a share-of cost Residential Smart Controller Direct Install program for qualified customers.

Average Savings our Customers are Achieving: **33%**

Click here to learn about enrolling in this conservation program.

Regional Rebates

Receive rebates from SoCal WaterSmart for a variety of water saving devices.

Average Savings our Customers are Achieving: **23%**

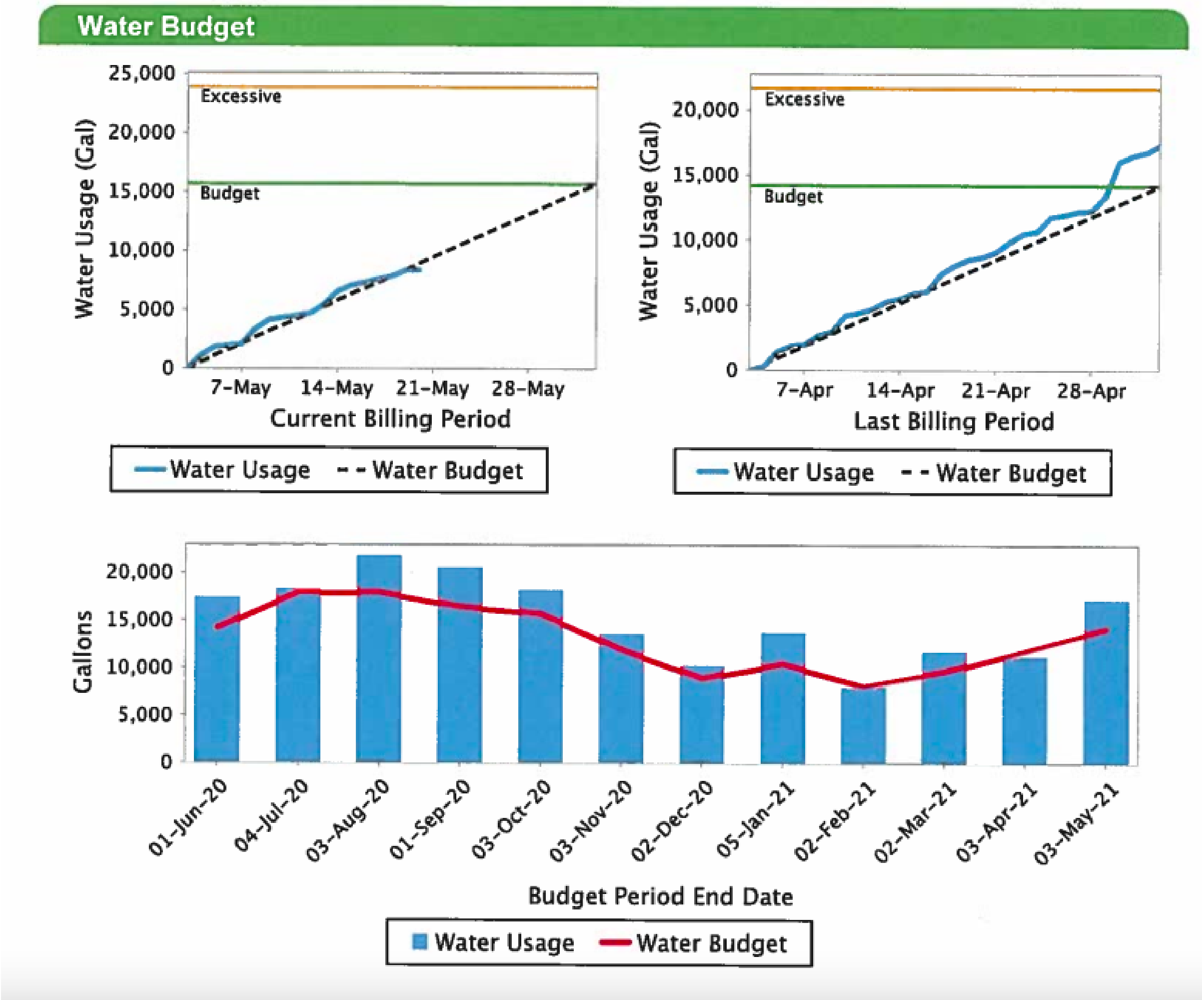
Click here to learn about enrolling in this conservation program.

HECW Direct Install

Average Savings our Customers are Achieving: **11%**

Not Enrolled

Figure 11 (continued). Conservation Scorecard



4.2.2.3 **Making AMI sign-ups simple and convenient** (Moulton Niguel Water District, California)

Utility profile
Service area: **Serves portions of six California cities, including Laguna Niguel, Laguna Hills, Aliso Viejo, Mission Viejo, Dana Point, and San Juan Capistrano** Service area connections: **55,500** Percent residential: **85%** Link to service area website: www.mnwd.com AMI roll-out stage: **roll-out completed in 2021** Percentage of AMI coverage: **100%** Year of AMI portal launch: **2016** Link to AMI portal: mywater.mnwd.com Percentage of customers registered in the portal: **70%**

The challenge: Increase the number of accounts registered in the customer portal.

Approach: Moulton Niguel has built its AMI strategy around the principle of enhancing customer convenience and taking customers' experience to the next level. The utility implemented their MyWater MNWD customer portal to act as a centralized location for their customers to access all the tools and information they need to manage their water utility account including AMI data, account information, customer rebate programs, billing information and leak alerts. Most importantly, the utility decided to use the portal as the primary vehicle for online and automatic bill pay causing an explosion of portal sign-ups when the consolidation was first implemented. Moulton Niguel also created a marketing strategy to educate customers about AMI and included customer friendly language, referencing AMI as “Smart Meters”. The utility has identified a number of touchpoints to prompt customers to sign-up for the customer portal and leak alerts with a high chance of success including:

- Bill Communication, email and postcard to inform customers that they would be receiving a technology upgrade to their water meter which would provide high resolution usage data that they could access with the customer portal. The notice contained a portal registration link and a QR code and prompted customers to sign-up for the portal and leak alerts.
- Door hangers were presented the day customers received the technology upgrade to their water meter. Informing customers that the upgrade had taken place and that the high resolution data could be accessed through the customer portal. The door hangers also contained a portal registration link and a QR code.
- Customer portal and AMI information walkthrough was offered to customers who called into Moulton Niguel’s dedicated water efficiency line or indicated interest in the utility’s free home water-savings survey. If a customer calling-in showed interest in a walkthrough, a customer service representative connected via FaceTime or Zoom to

help the customer explore the different portal options including how to read the high resolution data and sign-up for leak alerts.

- Ongoing bill communication includes regular references to leak alerts and prompts the customer to sign-up for the portal.

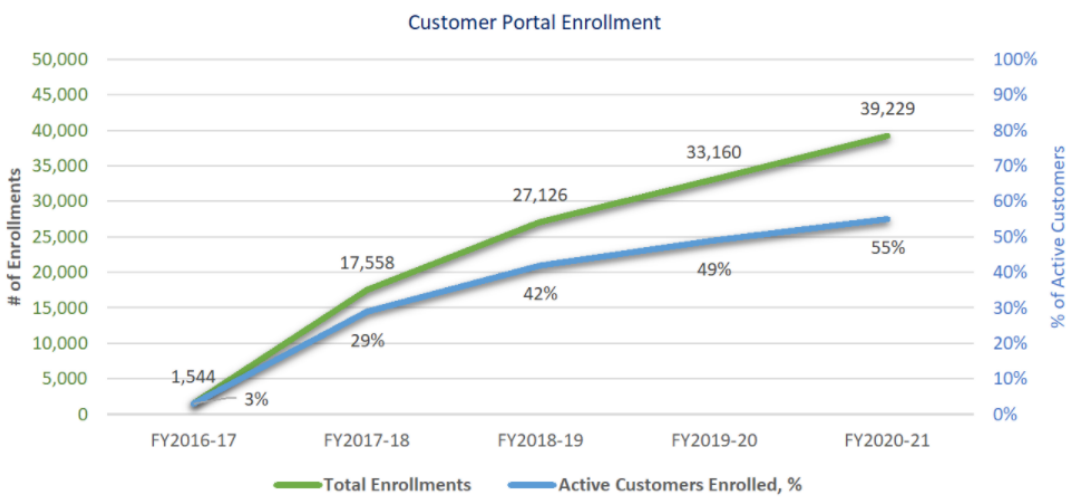
Interestingly, Moulton Niguel has also deployed an Enterprise View within its customer portal, which allows multi-family, commercial, and irrigation customers to develop portfolios to manage water and pay multiple bills in one transaction – a highly requested feature. Both the customer portal and Enterprise View are equipped with a unique feature that allows account owners to assign guest access to property managers and landscapers, which puts water use data into the hands of professionals responsible for managing water at the site.

Results: By streamlining access to the AMI portal and merging it with the online billing website, as well as by implementing the strategy outlined above, MNWD has increased its registered portal users from 3,000 to 39,000 (more than a 900% increase, see Figure 12), which is approximately 70% of the utility's customer base.

Lessons learned: In words of the utility managers, consolidating the AMI and the billing portals produced "an explosion of portal sign-ups". Similarly, communicating about AMI is most effective when done in a simple fashion (e.g. avoiding the term AMI and using "smart meter" instead) and at moments when customers are most receptive (e.g. when they pay their bills or call customer service). Being responsive to customer feedback (i.e. requests from large account managers for a better way to manage multiple accounts and perform several payment transactions simultaneously) made the portal more appealing to the multi-family and non-residential sectors.

Figure 12. Consumer sign-ups for MyWater

Note. Red line marks the time when the AMI portal was integrated into billing portal



4.2.2.4 Leveraging leaks and Home Water Use Reports as prompts to sign-up for AMI portal (City of Bend, Oregon)

Utility profile
Service area: **City of Bend, Oregon** Service area connections: **27,000** Percent residential: **83%** Link to service area website: https://www.bendoregon.gov/government/departments/utilities/water AMI roll-out stage: **roll-out completed in 2013** Percentage of AMI coverage: **100%** Year of AMI portal launch: **2019** Link to AMI portal: https://www.bendoregon.gov/government/departments/utilities/watersmart-software Percentage of customers registered in the portal: **15%**

The challenge: City of Bend Water regularly runs campaigns to promote water conservation among its residents. The city's AMI portal can help consumers better understand their water consumption patterns. However, only a small portion of its 27,000 customers have signed up for the portal, which limited its effectiveness.

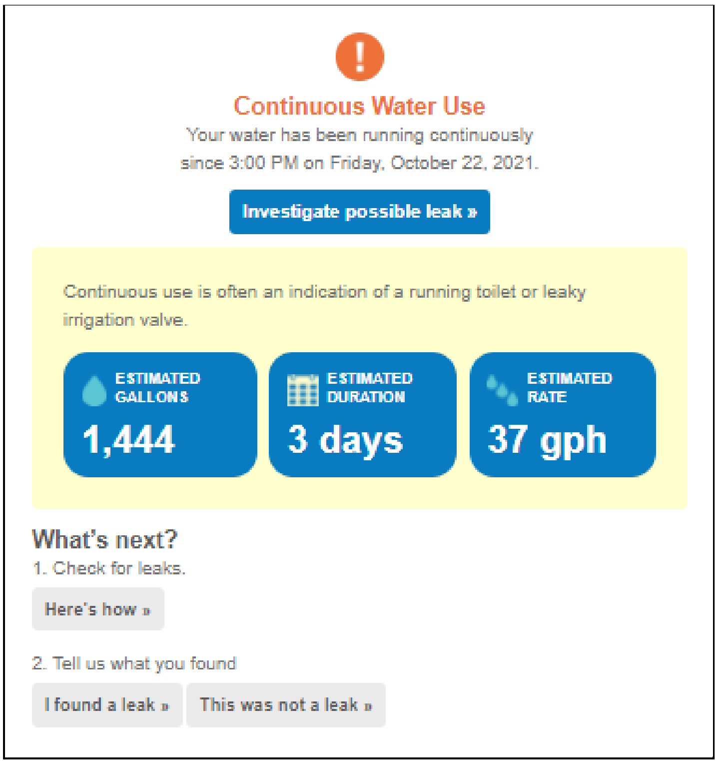
Approach: To increase the number of portal sign-ups, City of Bend Water has leveraged its Home Water Use Reports (i.e. monthly emails that regularly inform customers about their monthly water use) and automated leak alert communications. Both Home Water Use Reports and leak alerts now prompt customers to sign-up for the AMI portal. All Single Family Residential customers receive leak alerts by default and registered customers can customize their leak alert thresholds and notification options.

Once a customer is electronically alerted of a potential leak in their household, they are also presented with a link to a website to learn more about the leak (see Figure 13). Once at the website, customers are prompted to "dig a bit deeper" and better understand their water consumption by signing up for the AMI portal.

Results: Based on the utility's data, Home Water Use Reports account for 31% of all portal registrations. Similarly, leak alerts and related conversations account for another quarter (25.4%) of customer portal registrations. These results clearly identify the reports and leak alerts as the most effective ways to make customers sign-up for the AMI portal.

Lessons learned: Part of the strategy of delivering Home Water Reports is that most customers are not aware of their water use volume. Making water use data available to them generates interest and conversations about whether it is an adequate amount and motivates them to take further action. The strategy behind leak alerts success lies in the fact that during a potential leak event, customers tend to be much more motivated to understand their water usage patterns. The high personal relevance of the sign-up prompt can thus lead to a substantial number of customers to decide to register with the AMI portal.

Figure 13. Leak alert message that invites customers to investigate possible leaks by logging into the AMI portal



4.2.2.5 Building support for AMI through conversations with local communities (Global Water Resources, Inc., Arizona)

Utility profile
Service area: **City of Maricopa, Arizona** Service area connections: **24,274** Percent residential: **88%** Link to service area website: https://www.gwresources.com/ AMI roll-out stage: **roll-out completed in 2009** Percentage of AMI coverage: **100%** Year of AMI portal launch: **2009, switched to a new provider in 2018** Link to AMI portal: https://gwresources.watersmart.com/index.php/welcome Percentage of customers registered in the portal: **71%**

The challenge: Traditional channels to promote AMI – such as postcards, door hangers, and bill inserts – often fail to attract customers' interests as they feel generic and impersonal. Word-of-mouth recommendations by neighbors and respected community members can often go a long way in new technology adoption. However, creating such "community champions" who spread the word requires a water utility to personally engage and build trust with the community.

Approach: Global Water Resources (GWR) has organized a number of outreach events to strengthen its relationships with customers and foster the development of community champions. For example, during the earlier phases of AMI roll-out in the City of Maricopa, AZ, GWR periodically organized public "Open House" forums where customers could ask customer representatives and managers about AMI. Further, GWR has engaged with the municipality and presented the benefits of its AMI portal (see Figure 14 for portal interface) to City of Maricopa Council members, strengthening the utility's relationships with the local public officials.

Results: Currently, over 71% of residential customers have registered to use the GWR customer portal.   A number of community members are advocating for the AMI portal among the community, including the city's Vice Mayor. In 2021, the Vice Mayor advocated a community event that she regularly engages with the AMI portal and finds its features, such as leak alerts, extremely useful.

Lessons learned: Personally engaging with residents and local representatives through formal and informal events about AMI tend to produce strong validation that, according to the GWR's General Manager, "tends to go a long way in the community".

Figure 14. GWR's customer AMI portal interface

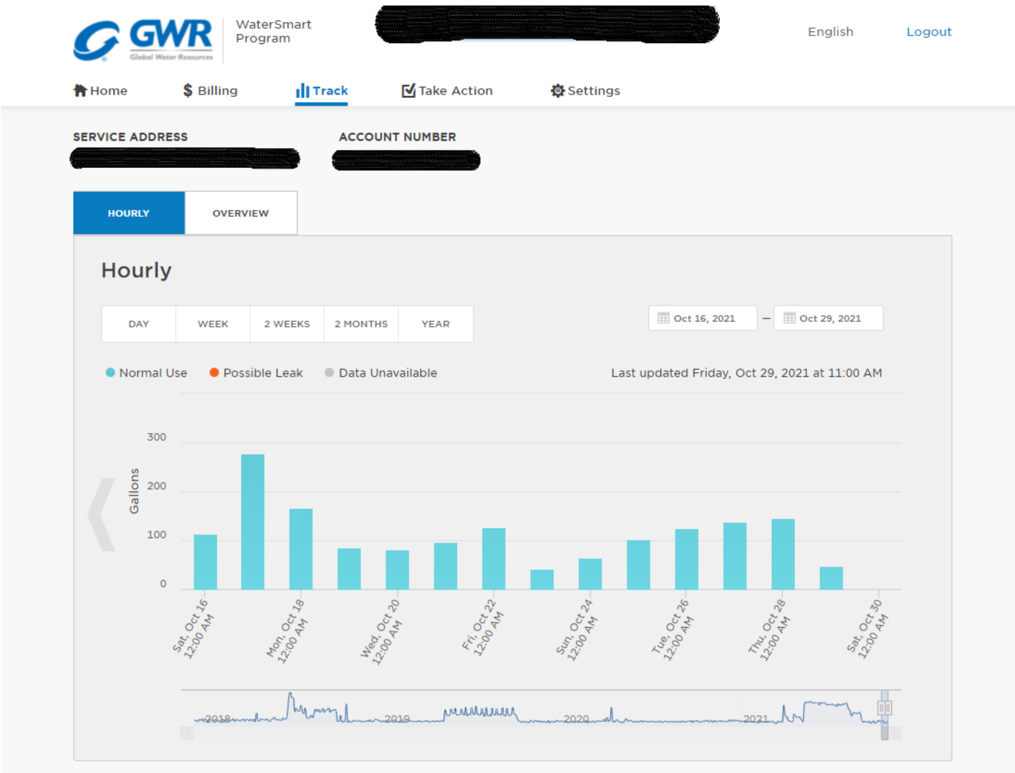
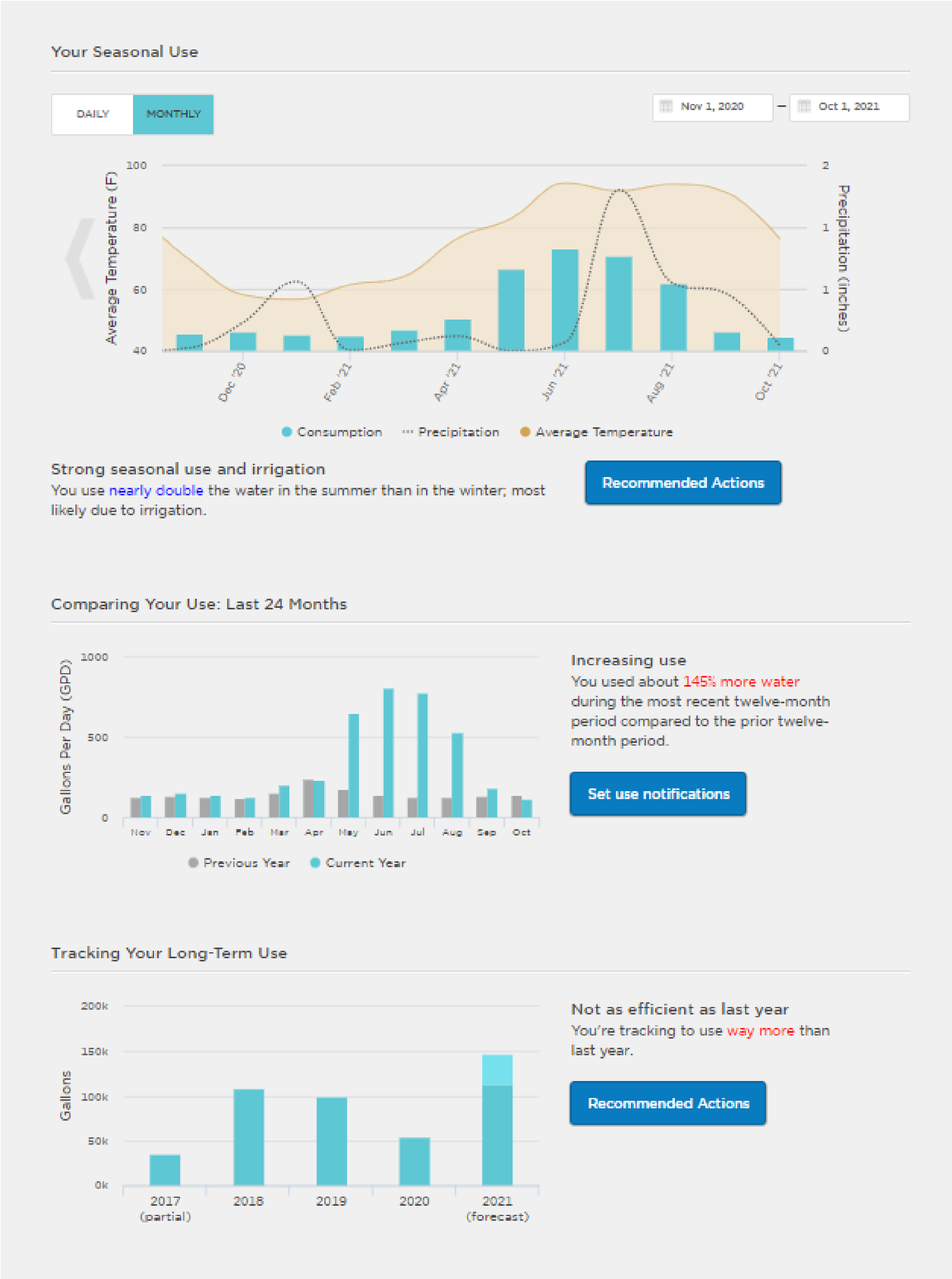


Figure 14 (continued). GWR's customer AMI portal interface



4.2.2.6 A personal approach: selling customers on the AMI customer portal (City of Beverly Hills, California)

Utility profile

Service area: **Beverly Hills and west half of West Hollywood, California**
Service area connections: **12,000**
Percent residential: **70%**
Link to service area website: www.bhsaves.org

AMI roll-out stage: **roll-out completed in 2008**
Percentage of AMI coverage: **100%**
Year of AMI portal launch: **2010**
Link to AMI portal: http://water.beverlyhills.org
Percentage of customers registered in the portal: **38%**

The challenge: The City of Beverly Hills recently decided to switch to a different customer portal for their AMI system in hopes of achieving two key improvements:

1) Single-Sign-On between the portal and billing and
2) More comprehensive support for conservation programming.

Only about 4,500 customers are currently signed up for the portal and the City hopes to increase that number by moving to Single Sign-On. Getting customers to sign up for the customer portal has many challenges including residents who only live in their homes part-time and have staff overseeing the property, residents who have lived in their homes for 60 years and are not computer savvy, and residents who are very busy and don't have time for one more thing to sign up for. The older, larger, and periodically occupied homes increase the changes for running toilets and underground pipe leaks that can go unnoticed for long periods of time and cause high volumes of water waste.

Approach: The City takes a very hands-on approach with their customers. The Water Conservation Administrator spends a lot of time on the phone, even taking calls outside of normal business operating hours. One way the City has helped leverage their first-generation portal was to customize leak alerts for those signed up on the portal. The City has a wide range of house and property sizes, staff uses their decades of water use experience to set each individual account's alerts. As the Water Conservation Administrator explained, "You could use house size to set a daily allowance, but I look at past usage and set their daily average at 10% over that. In addition, I use this time to educate the customer on ways they can improve their water usage." Conservation staff decided to target the most excessive water users, which are typically caused by over irrigation and running toilets. They do not focus on shorter showers or fewer flushes, because those activities have less volumetric impact on the water supply.

Staff enroll customers to sign up for the customer portal when they call the City about leaks or high bills. Staff explain the benefits which include reducing water waste, reducing utility bill costs, avoiding future leak headaches, and helping the City save water. It's a win-win-win.

Results: While most people do not sign into the portal regularly, they appreciate and benefit greatly from automated leak alerts. As one Customer Service Representative explained: "The number one thing the customers love about the program are the leak alerts, which could be a toilet continuously running, and the excessive daily use alerts which tell them they used more water than they typically do."

With the ability to send alerts, the City made much more contact, both personally and automated, with their customers than ever before:

The City's Water Conservation Administrator said, "love the data, love the charts!" that AMI can produce, and for anyone in the water industry who is passionate about saving water, the data is incredibly useful for them in their interactions with customers. One quote captures the outcomes of Beverly Hills' hands-on approach to portal engagement:

"What's great about the customer portal is it tells them there's an issue. And so people love knowing this. And because we have bigger, older homes, I believe we have more problems than most cities. It's great to let them know right away."

Lessons Learned: The best way to get customers signed up and using the portal is to make it clear how it's the answer to their problems. When customers call the city, city representatives should find a way to "sell" them on signing up as a way to make their life easier.

4.2.2.7 Piloting different AMI providers to find the right fit (City of Santa Barbara, California)

Utility profile
Service area: **Santa Barbara, California** Service area connections: **27,500** Percent residential: **66%** Link to service area website: http://www.SantaBarbaraCA.gov/Water AMI roll-out stage: **roll-out underway (expected completion in 2022-2023)** Percentage of AMI coverage: **0% (expected 100% in 2023)** Year of AMI portal launch: **expected 2023** Link to AMI portal: N/A

The challenge: Starting in 2019, Water Resources staff piloted a total of 400 water accounts on two AMI technologies (cellular & fixed) and three customer portal software options (EyeOnWater, Dropcountr, & WaterSmart). 200 of the pilot participants were assigned to a cellular network, which utilized the EyeOnWater software associated with the

Badger Beacon system. The other 200 were assigned to the Itron Choice Connect fixed network system, utilizing a single Cell Control Unit (CCU) installed in the City service area. Half of the fixed network system participants were assigned to the Dropcountr customer engagement portal and the remaining to the WaterSmart portal software. City staff managing the portal pilots had two goals for the test phase: to discover which functionalities they wanted for full roll-out, and to build momentum for the project among key decision makers. They made a list of stakeholders and included them in the pilots so that they could experience the portal interface, leak notifications, and water usage visuals from the interval data.

Approach: For pilot design, the City benefited from a block of hours with an experienced AMI consultant through a project with the Alliance for Water Efficiency. The City had also contracted out an AMI technology scan to understand the different technologies on the market and variables at hand.

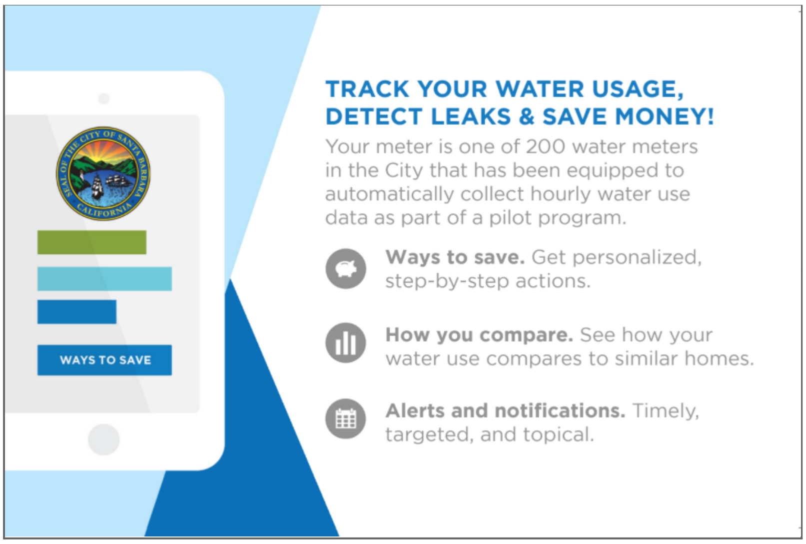
To promote the pilot to participants, conservation staff sent each customer a letter, a postcard (see Figure 15), and multiple emails to notify them of access to the pilot portal. Some customers were also contacted over the phone to encourage them to access their portal, especially customers with multiple accounts, like the school district. WaterSmart's feature of sending a personalized sign-up link to a user was especially useful. As a Water Resources Specialist explained, “A user doesn't have to look up their account number. They don't have to do anything but click on the link and then create a profile!” In general, however, phone calls with customers were time consuming enough that they don't anticipate having the capacity to do one-on-one phone calls to the same extent with a full AMI meter roll-out.

Finally, staff surveyed users with an online survey instrument to collect feedback on the pilot programs and users' thoughts on their water use. Survey reminders and links were sent in a letter to the account address as well as via email. They also partnered with a student researcher to do follow up phone calls with 10% of survey responders to get more in depth, qualitative feedback on customer experiences with the portal.

Results: The City of Santa Barbara felt confident with the data they collected from their careful and extensive piloting approach. Not only did they better understand their options in the portal space, but they could also decide together which features, add-ons, and base functionality worked best for both customers and City staff to meet their respective goals.

The pilot period made a major impact on how they designed the request for proposals so that they could get the best set of options for both AMI technology and the portal. Through the surveys, they were able to determine that week-by-week comparison data and leak alerts were the most useful tools for customers. Additionally, the survey instrument (Qualtrics) produced many useful infographics that staff could use in presenting outcomes from the pilots to decision-makers throughout the city.

Figure 15. Pilot sign-up postcard



Lessons Learned: Piloting different network and customer portal options helped the City build buy-in for the program and create the best possible request for proposals for their AMI system. Their experiences running the pilots helped them navigate the bids confidently and select the best vendor to meet their goals. Coverage and system issues demonstrated how critical adequate and redundant system signals are to avoid any loss of data availability to customers. The full implementation project was put out to bid in late 2020.

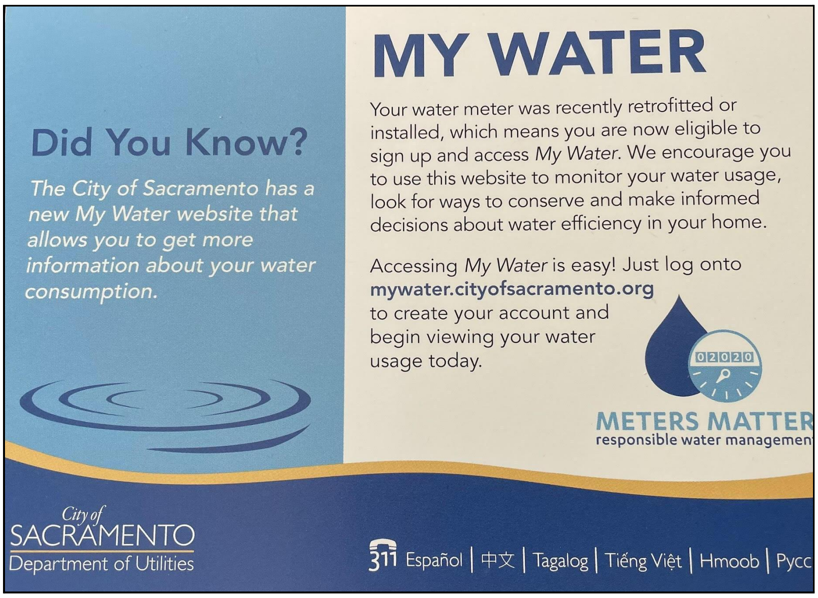
4.2.2.8 Automating leak awareness for conservation (City of Sacramento, California)

Utility profile
Service area: **City of Sacramento, California** Service area connections: **143,000** Percent residential: **93%** Link to service area website: https://www.cityofsacramento.org/utilities AMI roll-out stage: **roll-out completed in 2021** Percentage of AMI coverage: **100%** Year of AMI portal launch: **2015** Link to AMI portal: www.mywater.cityofsacramento.org Percentage of customers registered in the portal: **8%**

The challenge: After installing AMI, the City worked with the IT department to develop automated letter-mailing of leak notices for any account with more than 24 hours of continuous flow. During the drought in 2017, the City sent out 20,000 leak notices to customers (see Figure 17), but these did not turn into portal signups. The City struggled to find a way to convert automated leak alerts to increased portal sign-ups.

Approach: Hoping that leak notifications would increase sign-ups for the portal, the City included customer portal sign-up information in the leak notification. They tried several variations in leak thresholds to balance out the staff time, generating fewer letters by raising volumetric thresholds of 500 gallons a day over three days in the summer and lowering the threshold down below 125 gallons per day in the winter. In addition to leak notification letters, the City sent out postcards (see Figure 16) to its entire customer base to promote customer portal sign-ups.

Figure 16. AMI portal postcard



Results: While the notifications in particular were helpful in mobilizing customers to find and address leaks on their property, the letters resulted in a small increase in customer portal sign-ups. In 2021, the City had a 7-8% sign-up rate for its customer portals, with 100-200 customers signing up per month in 2021. Hotter weather months show a higher sign-up rate. For leak detection, lower detection thresholds resulted in more staff time, such that the City settled on higher thresholds for leak detection. The City saved staff time by reducing home visits for leak detection, only offering them on request instead of in response to evidence of a leak.

Lessons Learned: Mass mailing postcards did not increase portal signups. Instead, targeted leak alert letters encouraged greater customer sign-ups with people looking to find and resolve leaks on their own.

Figure 17. Leak alert letter

City of
SACRAMENTO
Department of Utilities

«Name»
«Address1»
«Address2»
«Address3»
«City» «State» «Postal»

August 9, 2021

URGENT COURTESY FOLLOW UP NOTICE! YOU MAY HAVE A LEAK!

Dear Customer:

The Department of Utilities automated water meter read system continues to indicate nonstop water use at: **«Address1_Prem»**.

We estimate that you may be losing approximately **«Gals_Lost»** gallons per day.

Irregular use can often indicate an indoor leak (such as a leaky toilet) or outdoor irrigation system leak (such as a leaky valve). This is a courtesy notice only: *the repair of private water lines connected to the City's point of service are the sole responsibility of the customer*.

Test your toilets for leaks by adding food dye to the tank, wait a few minutes and see if the food dye has shown up in the toilet bowl which indicates a leak. Also, check your irrigation system for leaks. If you cannot find the leak, we encourage you to contact a plumbing professional to fix the leak(s).

During the current COVID-19 pandemic, the City can also virtually assist you in identifying the reason for the irregular water usage however the **customer is still responsible for repairing the leak**. You may call us to schedule a virtual leak inspection. During a virtual leak inspection, a Water Conservation Representative will work with you to narrow down the source of the leak and may provide recommendations for using water wisely, indoors and out, and details on our rebate programs.

In addition, the City has a free web-based portal that will allow you to track and be notified of any abnormal usage, view your hourly and daily usage, and set leak alerts in the future. To create your own account, please visit mywater.cityofsacramento.org.

The table below provides a conversion of gallons to cubic feet for the estimated water loss:

Gallons/day Loss	Gallons/month Loss	Cubic Foot (CF) conversion
100	*3,000*	401
250	*7,500*	1,003
500	*15,000*	2,005
1,000	*30,000*	4,010

We are here to assist you in identifying ways to save money by saving water. To schedule a virtual leak inspection, please call 311 or 916-264-5011.

Sincerely,

Water Conservation Office, Department of Utilities

Water Conservation Office | 5730 24^{TH} St, Building 22 | Sacramento, CA 95822 | Phone: 916-264-5011

CIR-AMILEAK (03/26/2020)

4.2.2.9 Avoid leaks, save continuously? Understanding the different needs of residential and industrial customers (City of Gainesville, Georgia)

Utility profile
Service area: **City of Gainesville and unincorporated Hall County, Georgia** Service area connections: **60,000** Percent residential: **89%** Link to service area website: https://www.gainesville.org/255/Water-Resources AMI roll-out stage: **roll-out underway** Percentage of AMI coverage: **100%** Year of AMI portal launch: **2017** Link to AMI portal: https://my-gnvl.sensus-analytics.com/ Percentage of customers registered in the portal: **4%**

The challenge: As the City of Gainesville made the transition to AMI, they planned a big outreach effort for their entire customer base of just about 60,000 accounts. After sending out nicely designed postcards and email blasts, sign-ups were not what they had hoped: only 2,600 customers signed up out of 60,000 (4 %). The low response made the City realize that in order to significantly increase AMI portal sign-ups, a more tailored approach with their customers is necessary.

Approach: Understanding the different sets of motivations of residential and industrial customers to engage with AMI proved valuable when thinking about the next customer engagement strategy. One of the main observations is that residential customers tend to "set and forget" anything about their water use, and only come looking for information when there are problems. On the contrary, businesses seek the ability to track their water usage hourly, as their higher water consumption rates offer much more space for achieving significant savings.

The result: Water Resources did not continue mass email or mailer campaigns. Instead, they try to make portal sign-ups as easy and timely for residential customers as possible. For example, the utility focuses on signing up new customers, as they tend to be more interested and engaged in the information communicated to them by the utility. Furthermore, "opt in" leak alerts have not produced the results the utility has hoped for, so in the future the City plans to use an "opt out" system for leaks alerts to make the leak enrollment automatic and effortless. Gainesville saw great success with their commercial and industrial water users, so much that the City reports "that's where we're getting our money's worth on the portal". Gainesville has a large poultry industry, three of which are their top water customers in the entire district. The poultry plants do zero based budget billing, and their staff use the portal to track water hourly. They keep close attention to how much water is used per 8-hour shift or even how much water is used to process one chicken. Poultry managers make immediate interventions to conserve water where they can. If for some reason the portal has a problem, they call immediately. Another top water user is an account with five fast food restaurants. They keep a close eye on their irrigation use and use the portal to track and follow up on any irregularities.

Lessons learned: Whereas high-consumption industry customers are attracted by the potential to track their hourly water consumption and achieve savings on a day to day basis, most residential customers are not attracted to this functionality. Instead, they look to avoid leaks and manage their water consumption as effortlessly as possible. Targeting these motivations when speaking to different types of customers is a much more promising path forward than relying on generic email blasts and mass promotions.

4.2.2.10 AMI for improving drought response (City of Fort Collins, Colorado)

Utility profile
Service area: **City of Fort Collins, Colorado** Service area connections: **36,000** Percent residential: **92%** Link to service area website: fcgov.com/save-water Commercial: fcgov.com/water-efficiency AMI roll-out stage: **roll-out completed in 2015** Percentage of AMI coverage: **100%** Year of AMI portal launch: **2019-2020** Link to AMI portal: *fcgov.com/mywater* Percentage of customers registered in the portal: **15%**

The challenge: With AMI fully deployed to their residential and commercial customers, Fort Collins Utilities (Utilities) had two challenges ahead. The service area was at risk of a water shortage in fall 2020. To reduce demand, water restrictions were declared from Oct. 1 to Nov. 9, and Utilities needed to communicate to customers about reducing demand through restrictions. The customer portal was relatively new and the staff was limited by recent communication policies related to the frequency and the acceptable number of customer emails. Unable to send email blasts or mass mailers to customers to promote their MyWater portal (see Figure 18), conservation staff had to get creative about how to communicate with their customers.

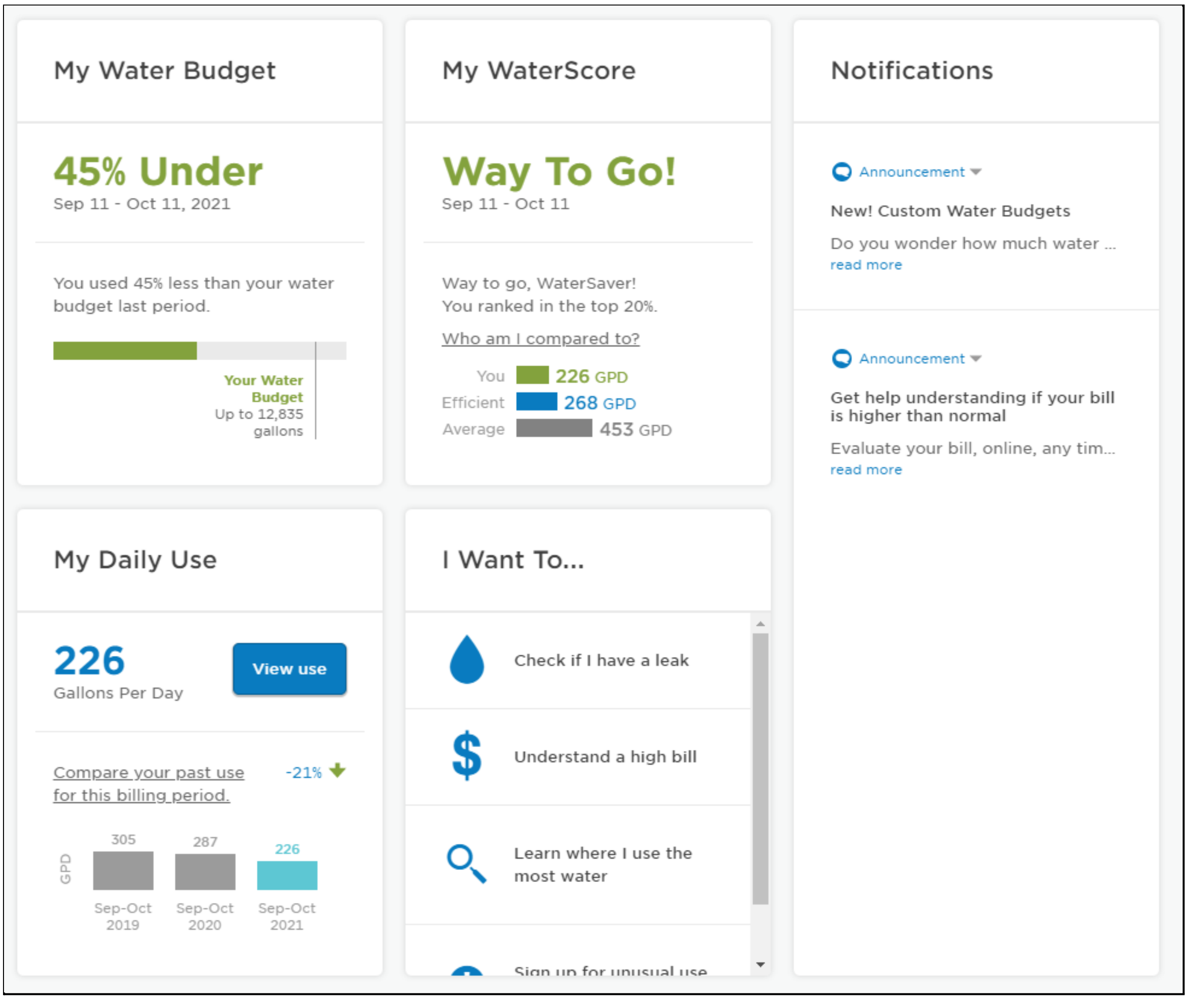
Approach: Utilities promoted the portal in bill inserts twice a year, with limited response. Given the severity of water shortage conditions, the water utility is permitted to notify customers directly with information related to water restrictions. Conservation staff took advantage of the opportunity in fall 2020 to promote the customer portal to track water use data and reduce demands. Sending an email to all water customers with a link to the portal and login instructions sparked the largest uptick to date in residential portal use.

Utilities took a different approach with their 3,000 commercial accounts. To participate in education programs or receive a water audit, commercial customers were required to register in the portal. Leak alerts were turned on when a commercial customer signed up.

Finally, Utilities worked with WaterSmart to create a custom portal feature that enabled customers to track their annual allotments.

Results: Fort Collins Utilities saw a significant increase in residential customer signups from these actions, with 5,250 out of 36,000 customers currently signed up, including 3,800 of the 30,000 single-family residential customers. Prior to the water shortage, only 2,600 customers were signed up. In the following five weeks of restrictions, 600 more customers had registered on the portal. Customers tend to check the portal monthly and view messages when they pay their water bills. In a survey of residential customers, 65% of respondents reported they had successfully found and fixed a leak after being notified by WaterSmart.

Figure 18. MyWater portal customer interface by WaterSmart



The commercial side has been a portal success. At least 60% of irrigation customers are signed up for the portal and use it regularly. Conservation staff relates some of the sign-up numbers to requirements attached to programs and incentives.

The portal was invaluable during the water shortage for customers and conservation staff. Staff uses the portal to track compliance with outdoor watering restrictions and send emails as needed for enforcement. This saves staff time and resulted in increased compliance numbers when AMI data was reviewed in the following days and weeks. Finally, customer service representatives have found that the custom allotment variable is incredibly helpful in their work to help customers save water and stay within their allotments.

Lessons Learned: Water shortages and droughts are an opportunity to greatly expand customer portal signups. It is a time when customers are paying closer attention, monitoring their use to comply with restrictions, and when some utilities can email to all customers more broadly. Additionally, requiring customers to sign-up for the portal and leak alerts to participate in conservation programs is much more effective than making portal signup optional.

4.2.2.11 Using a tailored approach in promoting AMI to over-irrigating customers (New York American Water)

Utility profile
Service area: **State of New York** Service area connections: **126,500** Percent residential: **98%** Link to service area website: amwater.com/nyaw AMI roll-out stage: roll-out underway (expected completion in 2025) Percentage of AMI coverage: **13%** Year of AMI portal launch: **2020** Link to AMI portal: login.amwater.com

The challenge: Excessive irrigation is one of the key causes of high water consumption and high water bills in New York. According to the utility's data, water consumption rates in the summer are almost triple the amount consumed in winter, with lawn irrigation being the primary reason for the increased summer usage. In many cases, customers simply do not know how often or when they should water their lawns. In such instances, AMI offers a powerful tool to help households realize excessive irrigation and understand how to change their watering patterns to keep the water consumption and bills low.

Approach: Apart from sending mass communications about the portal (see Figure 19 for an example of a leaflet), the utility had decided to take a personal approach with customers who regularly consumed more than 15,000 gallons per month. In the summer of 2021, the utility reached out to approximately 5,300 of its 14,000 AMI customers who were at or on target to reach the 15,000-gallon per month threshold. Customer Service Representatives communicated with each of these customers via letter and explained how signing up for the AMI portal can personally benefit their household. Further, the utility also offered discounts on the purchase of irrigation controllers to help customers limit their water usage. By combining the personalized outreach with incentives, the utility was striving to increase portal sign-ups and reduce water consumption among customers with excessive usage.

Results: Out of the 5,300 AMI contacted households, 11.8% signed up to the AMI portal. According to the utility manager, lowering their bill was the key motivator for over-irrigating customers to sign-up. Most importantly, those who registered to the portal reduced their consumption by 5.5 % compared to the over-irrigating customers who did not sign-up. Finally, 5.6% of AMI customers who signed up to the portal also purchased the irrigation controllers offered by the utility, which further helped reduce their water consumption.

Lessons Learned: By focusing on a narrow group of customers, the utility was able to take a more personal approach which likely increased the number of successful conversions compared to sending generic communications. The utility has also learned that following up at least twice with customers who initially didn't sign-up for the portal is a simple yet effective method for driving additional portal registrations.

Figure 19. NY American Water leaflet explaining benefits of AMI

05 Findings from four field experiments on engagement with AMI portals

5.1 Increasing AMI portal sign-up

We conducted three field trials in collaboration with Mount Pleasant Waterworks, City of Bend, and City of Gainesville, respectively, to design communications that encourage customers to sign-up to AMI portals. In all threeexperiments, we randomly assigned customers to either the control group or one of three treatment groups. The control group received no communications while the treatment groups received different versions of emails through which behaviorally informed interventions were delivered. The emails went out to all those assigned to the treatment groups who have AMI installed, who can be reached via email, and who had not signed up to the AMI portal by the onset of the trial.

5.1.1 Summary of the main findings

The trials showed that the simple act of sending emails to encourage or remind customers to sign-up for AMI portals is very effective in increasing portal sign-up rates: sending the emails produced up to a 213% increase in portal sign ups in the weeks following the intervention. As demonstrated by the different versions of the communications we tested, it is important to keep messages simple, so that information does not distract from the main call to action. Out of the four communication designs that we tested, we found that all of them, except for the dynamic norm version, performed equally well in our contexts.

> Sending emails to encourage or remind customers to sign-up for AMI portals produced up to a 213% increase in portal sign ups.

In terms of the effects on water consumption, we found suggestive evidence that AMI portals may encourage water savings. Specifically, signing up for a portal resulted in a reduction of 5 to 9 gallons in daily water consumption (a 6-12% change). However, the identified effect was not statistically significant. Further research that includes a larger sample of customers is required to achieve the sample size needed to detect this type of effect. For future studies, it would be helpful to also investigate the level of engagement with the portal for those who signed up. For example, it is important to assess whether those who signed up actually ended up logging in and using the portal features.

> Signing up for a portal resulted in a reduction of 5 to 9 gallons in daily water consumption (a 6-12% change). However, the identified effect was not statistically significant.

Overall, this trial shows that behaviorally-informed communications can be used to effectively and positively influence customer behavior. There are many other applications that could be pursued by utilities, such as interventions that directly target water consumption (for example during water shortages); encourage the reporting of leaks; promote the timely payment of bills; or improve the understanding of tiered pricing systems. These interventions can and should also be evaluated using randomized controlled trials so that utilities can continue making evidence-based decisions that are informed by robust evidence.

5.1.2 Experimental design

This section describes the experimental design and provides details regarding the behavioral interventions included in the emails. We also provide information on the sample of participants and the spread across treatment groups in this section.

5.1.2.1 Main intervention

At the beginning of the experiments, we randomly assigned one-quarter of each of the utility's customer base to each of the following main intervention groups:

- **Control group:** received no communication as a part of this trial
- **Treatment group 1:** received a short communication about the AMI portal
- **Treatment group 2:** received the same communication as treatment group 1, with the addition of a 'dynamic norm statement'
- **Treatment group 3:** received the same communication as treatment group 1, with the addition of an incentive or loss-framed message

For the main intervention, those assigned to the control group received no communication as part of the trial. Treatment group 1 received a short email that highlights portal features and benefits and prompts them to sign-up to the AMI portal, as illustrated in Figure 20.

Treatment group 2 received the same email as treatment group 1, with the addition of a 'dynamic norm statement'. More specifically, we framed signing up for the portal as an act of joining many others who have already done so by adding the statement: "*Become an early adopter by joining thousands of people who are signing up for the portal!*"

Treatment group 3 also received the same email as treatment group 1, with the addition of a loss-framed message or an incentive to sign up. For Mount Pleasant and Gainesville customers, we framed the information about portal features as benefits the customer is missing out on by adding the text: "*As you are not currently registered, here's what you are missing out on*". On the other hand, Bend customers were incentivized with the opportunity of entering a lottery to win a $100 bill credit for signing up. All participants assigned to the treatment groups had the sign-up link included in the email and can easily complete their sign-ups should they decide to do so.

Figure 20. Vanilla email sent to treatment group 1

MOUNT PLEASANT WATERWORKS CLEAN WATER

WaterSmart is now live!

Your Online Engagement & Water Insight Tool

Hello [*Name*],

Mount Pleasant Waterworks is delighted to offer you exclusive access to our **FREE** water use customer portal.

You will be able to track your water consumption, set threshold and leak alerts, view and pay your bills online, as well as gain access to other useful features.

What's in it for you?

- **Track and understand your water use with our detailed analysis**
- **Avoid billing surprises by setting usage alerts that best suit your needs**
- **Receive updates and notifications promptly via your preferred channel**
- **Get interactive money- and water-saving recommendations customized for you**
- **Achieve smarter water use and lower monthly bills**

To start enjoying these benefits, all you have to do is register using your zip code and your account number (*account number*).

CLICK HERE TO SIGN UP FOR THE PORTAL

You can find more information about the portal online. You may also email us or call customer service at (843) 884-9626 for assistance.

Be a smart water user and sign up today!

Thanks for caring about your water use,
[*Staff Name*]
[*Position*]

To minimize the number of people who did not sign-up merely because they forgot to do so (or because they missed the initial email), we sent a reminder email to those who had not signed up. In the next section, we describe how the reminder emails were designed and assigned to customers.

5.1.2.2 Reminder

We sent a reminder to every customer who has not signed up for the portal two weeks after they received the initial communication. We randomized these customers to receive one of the two versions of the reminder:

- **Reminder group 1:** received a simple reminder to sign-up that is based on the communication sent to the main treatment group 1 above.
- **Reminder group 2:** received the same reminder as reminder group 1, with the addition of an active choice. Specifically, the email prompted customers to either sign-up for the portal or take a short survey to tell us the reason for not signing up. Figure 21 illustrates the active choice design included in the reminder.

Figure 21. Active choice design

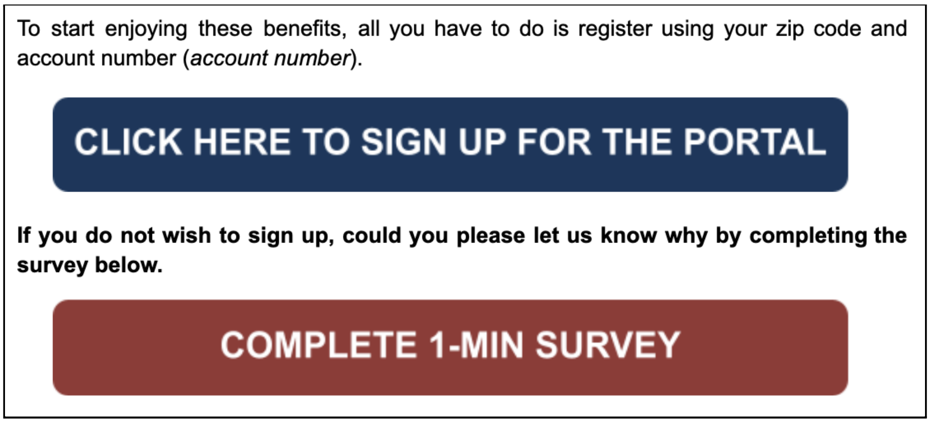


Figure 22 describes the experimental design of the trial. Example copies of the communications that were sent (both the main intervention and the reminder) can be found in the Appendix.

5.1.3 Data

This section provides information on data sources and sample sizes.

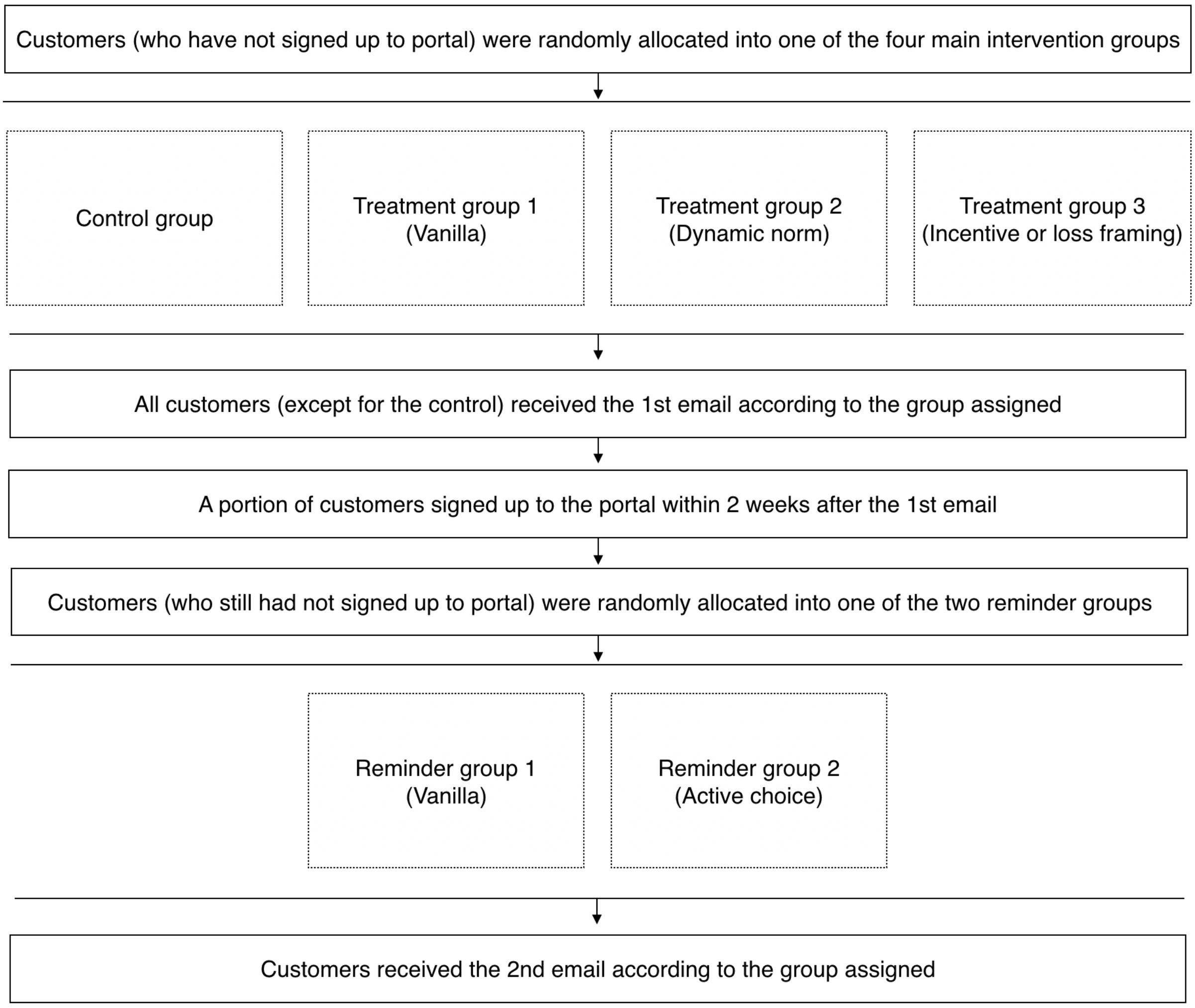
The data used to randomize the trial participants, and to measure outcomes, come from the following sources:

- Utilities' administrative data (e.g., customer IDs and postcodes)
- CRM data (e.g., whether emails were opened and links included in the email were clicked by participants)
- Survey data (information on why participants chose not to sign-up)

Our sample for this experiment consists of 57,401 individuals from three utilities. The breakdown of sample size for each individual utility involved in this trial is as follows:

- Mount Pleasant: 13,590
- Bend: 10,211
- Gainesville: 33,600

Figure 22. Experimental Design



5.1.4 Results

In this section, we present the results from the trial. Our primary outcomes of interest include:

- Whether customers signed up to the portal
- Whether customers opened the email and clicked on the link in the email
- Whether customers changed their level of water consumption

5.1.4.1 Effect of interventions on portal sign-up

Table 1 shows the overall effect of the communications (including the main intervention and the reminder) on portal sign-up rates for all three utilities, both individually and combined.

In general, all treatment across all utilities had statistically significant positive effects on portal sign-up rates. This can be observed in columns 1 to 3 where we assessed the effects for individual utilities, and in column 4 where we aggregated the samples from Mount Pleasant and Gainesville and assessed the effects for the pooled sample.

In terms of the magnitude of the effects, they are similarly and considerably large for two of the utilities. For example, we observe an effect size of 5.78 percentage points in the loss framing intervention for Mount Pleasant and 6.16 percentage points in the incentive intervention for Bend. While these numbers may not seem large on their own, they represent a 147% and 219% increase respectively relative to the control groups' original sign-up rates.

Table 1. Overall effect of the treatment on portal sign-up rates

	(1) Mount Pleasant	(2) Bend	(3) Gainesville	(4) Pooled
Vanilla	0.0549***	0.0558***	0.0109***	0.0236***
	(9.16)	(8.73)	(8.82)	(11.91)
Dynamic norm	0.0431***	0.0610***	0.00501***	0.0161***
	(7.50)	(9.34)	(5.44)	(8.83)
Loss framing	0.0578***		0.0128***	0.0252***
	(9.42)		(9.68)	(12.45)
Incentive		0.0616***		
		(9.45)		
Constant	0.0393***	0.0281***	0.00107***	0.0122***
	(11.85)	(8.66)	(3.00)	(12.07)
Observations	13590	10211	33600	47190

Notes: Each cell in the table tells us what the difference in the sign-up rate is between the control group and the group represented in that particular row. The only exception is the row representing the control group (i.e., constant), which tells us what the sign-up rate was in the control group after the interventions were delivered. In other words, to get the total sign-up rate in, for example, the dynamic norm group for Bend, we would add 0.061 (increase in sign-up rate relative to the control group) to 0.0281 (the sign-up rate for the control group) to obtain 0.0891 (i.e., 8.91%). Columns 1-3 show the results for individual utilities and Column 4 shows the pooled results from two utilities–Mount Pleasant and Gainesville. T statistics in parenthesis. * $p<0.1$ ** $p<0.05$ *** $p<0.01$.

While all interventions were effective in increasing portal sign-up rates, one may be interested in their relative effectiveness when compared to each other. To assess and identify the intervention that performed better than the others, we present Table 2 which shows the comparative effects of different intervention types on portal sign-up rates for all three utilities, both individually and combined.

Two observations stood out from Table 2. First, the dynamic norm treatment is found to be significantly less effective than the vanilla treatment for all utilities except for Bend. Second, there is no statistically significant difference in effects between the loss framing or the incentive treatment and the vanilla treatment. In other words, they performed equally well in increasing portal sign-up rates.

Table 2. Comparative effect of the treatment on portal sign-up rates

	(1) Mount Pleasant	(2) Bend	(3) Gainesville	(4) Pooled
Dynamic norm	-0.0119*	0.00514	-0.00594***	-0.00749***
	(-1.73)	(0.65)	(-4.07)	(-3.27)
Loss framing	0.00288		0.00190	0.00156
	(0.40)		(1.09)	(0.64)
Incentive		0.00573		
		(0.73)		
Constant	0.0943***	0.0839***	0.0120***	0.0358***
	(18.85)	(15.21)	(10.11)	(20.94)
Observations	10157	7609	25200	35357

Notes: Each cell in the table tells us what the difference in the sign-up rate is between the vanilla treatment group and the group represented in that particular row. The only exception is the row representing the vanilla group (i.e., constant), which tells us what the sign-up rate was in the vanilla treatment group after the interventions were delivered. Columns 1-3 shows the results for individual utilities and Column 4 shows the pooled results from two utilities–Mount Pleasant and Gainesville. T statistics in parenthesis. * p<0.1 ** p<0.05 *** p<0.01.

The following two graphs illustrate the effects of sending utility customers behaviorally-informed communications on portal sign-up rates. Figure 23 plots the share of customers in each intervention group (for Mount Pleasant and Gainesville) who signed up to the portal after the interventions were delivered. The figure shows graphically that customers in all three treatment groups have higher sign-up rates than their counterparts in the control group. Figure 24 plots the cumulative daily sign-ups to the Mount Pleasant AMI portal. As shown in the figure, there were spikes observed for all treatment groups immediately after the main treatment email and the reminder email were sent out on October 14 and November 1 respectively. For the control group, no such effects were observed.

Figure 23. Share of customers who signed up to portal categorized by main treatment group

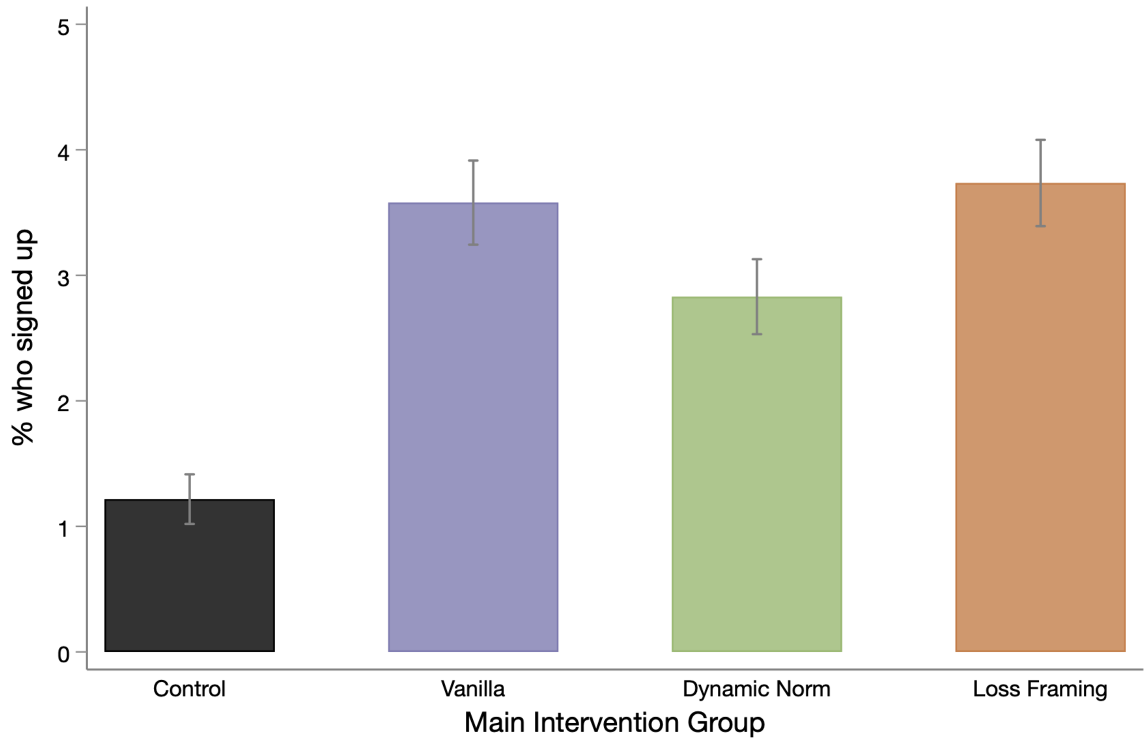
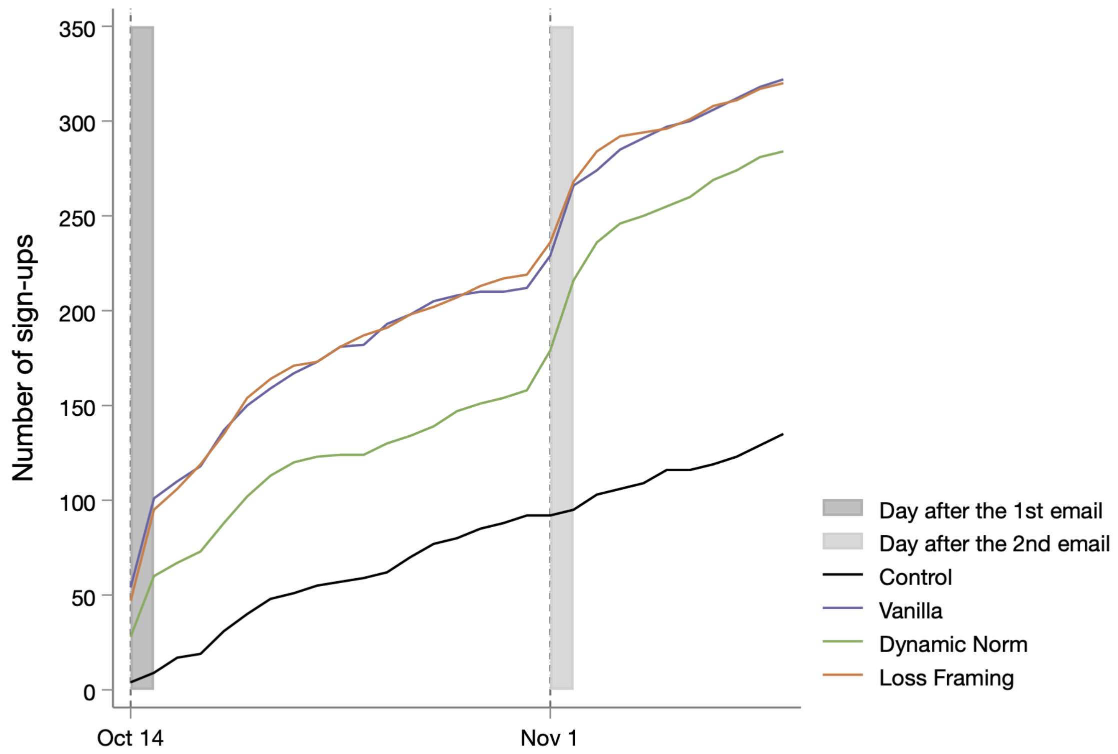


Figure 24. Cumulative daily sign-ups by main treatment group



5.1.4.2 Effect of interventions on email open and click rates

In this section, we discuss the effect of behavioral communications on email open and click rates. As different email subject lines were used (in addition to different email content and framing) in the trial for each of the treatment groups, we might expect different email open and click rates as a result.

The following two tables show the comparative effects of different intervention types for two utilities (Mount Pleasant and Bend). Table 3 shows the effects for the main intervention while Table 4 shows the effects for the reminder.

Table 3. Comparative effect of the treatment on email open and click rates (main intervention)

	Main email open rates		Main email click rates	
	(1)	(2)	(3)	(4)
	Mount Pleasant	Bend	Mount Pleasant	Bend
Dynamic norm	-0.0410***	0.0336**	-0.0283***	-0.000791
	(-3.41)	(2.40)	(-4.66)	(-0.13)
Loss framing	0.00685		0.00517	
	(0.56)		(0.76)	
Incentive		0.0717***		0.00220
		(5.17)		(0.36)
Constant	0.572***	0.529***	0.0817***	0.0491***
	(67.27)	(53.32)	(17.36)	(11.42)
Observations	10056	7609	10056	7609

Notes: Each cell in the table tells us what the difference in the email click rate or open rate is between the vanilla treatment group and the group represented in that particular row. The only exception is the row representing the vanilla group (i.e., constant), which tells us what the email click rate or open rate was in the vanilla treatment group after the main emails have been delivered. T statistics in parenthesis. * $p<0.1$ ** $p<0.05$ *** $p<0.01$.

For the main intervention, the incentive treatment appears to have been more effective than the vanilla treatment in leading to participants opening the email (but not clicking the link). This effect is observed in participants from Bend, where there is a statistically significant 7.17 percentage point change (which translates into a 13.5% increase) in email open rates.

We found no significant differences between the loss framing treatment and the vanilla treatment in either the email open rates or the email click rates. However, we found mixed results for the dynamic norm treatment. On one hand, for Mount Pleasant, the dynamic norm treatment appears to have been less effective than the vanilla treatment in getting participants to both open the email and click the link. On the other hand, for Bend, the dynamic norm treatment appears to have been more effective than the vanilla treatment in getting participants to open the email (but not to click the link).

For the reminder, we found that the active choice treatment was more effective than the vanilla treatment in leading to participants opening the email but not clicking the link in the email. The effect on email open rates was driven by participants from Bend, where there is a 4.63 percentage point increase that is statistically significant. Such effects were not observed for participants from Mount Pleasant.

Table 4. Comparative effect of the treatment on email open and click rates (reminder)

	Reminder open rates			Reminder click rates		
	(1)	(2)	(3)	(4)	(5)	(6)
	Mt. Pleasant	Bend	Pooled	Mt. Pleasant	Bend	Pooled
Active choice	-0.000845	0.0463***	0.0197**	-0.00209	0.0103*	0.00346
	(-0.08)	(3.98)	(2.55)	(-0.36)	(1.92)	(0.87)
Constant	0.586***	0.570***	0.579***	0.0840***	0.0484***	0.0684***
	(80.07)	(68.56)	(105.38)	(20.39)	(13.44)	(24.36)
Observations	9190	7111	16301	9190	7111	16301

Notes: Each cell in the table tells us what the difference in the reminder email click rate or open rate is between the vanilla reminder group and the active choice reminder group. The row representing the vanilla group (i.e., constant) tells us what the reminder email click rate or open rate was in the vanilla reminder group after the reminder emails have been delivered. T statistics in parenthesis. * p<0.1 ** p<0.05 *** p<0.01.

5.1.4.3 Effect of signing up for the portal on water consumption

While it is certainly encouraging to find that sending simple communications to customers leads to higher portal sign-up rates, an interesting question to further examine is whether signing up for the portal results in reduced water consumption.

To assess the effect of portal sign-up on water consumption, we conducted analysis on water consumption data provided by Mount Pleasant using an instrumental variables (IV) approach. Table 5 shows the balance between treatment groups, confirming that the randomisation was conducted correctly, and that the treatment groups were statistically 'identical' at baseline.[9]

[9] Achieving balance at baseline allows us to interpret any subsequent differences between the groups as the causal effects of the treatments.

Table 5. Balance across treatment groups

Variable	(1) Control Mean/SE	(2) Group 1 Mean/SE	(3) Group 2 Mean/SE	(4) Group 3 Mean/SE	T-test Difference (1)-(2)	(1)-(3)	(1)-(4)	(2)-(3)	(2)-(4)	(3)-(4)
High baseline consumption	0.500	0.503	0.496	0.495	-0.003	0.004	0.005	0.007	0.008	0.001
	[0.009]	[0.009]	[0.009]	[0.009]						
Live in zip code 29464	0.519	0.522	0.533	0.514	-0.003	-0.014	0.005	-0.011	0.008	0.019
	[0.009]	[0.009]	[0.008]	[0.009]						

Notes: This table shows the balance across treatment groups for the Mount Pleasant trial. 'High baseline consumption' is a dummy variable that equals 1 if the individual's baseline consumption is in the top 50%. 'Live in zip code 29464' is a dummy variable that equals 1 if the individual resides within the zipcode of 29464 instead of 29466 (where the other half of the participants live). The value displayed for t-tests are the differences in the means across the groups. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Table 6 shows the effect of signing up for the AMI portal on water consumption. The first two columns show the effect of promoting the portal using email communications while the second two columns show the effect of actually signing up for the portal.

We found that portal sign-ups led to an average decrease in daily water usage in the range of 5 to 9 gallons (which translates to daily savings in the range of 6.3 to 12.1%). However, this effect should be interpreted as indicative as it lacks power and is not statistically significant. In other words, this is an encouraging, albeit suggestive, result.

5.1.4.4 Insights from qualitative survey

Participants in the active choice condition for the reminder email had the option of taking an additional short survey. In the questionnaire, participants were asked to indicate their reasons for not registering for the AMI portal.

Only 18 respondents across the three utilities took the survey. Seven participants typed in their own reasons for not signing up for the portal. Some pointed out the inconveniences associated with signing up. For example, one respondent mentioned: "*Your software should automatically load the account number. Way too long to expect someone to enter.*" Similarly, another participant noted: "*First an account # to look up. Then create another password. Forget it.*" One participant wrote that he would register if the AMI portal is integrated with the billing portal: "*I have 2 accounts. If I could have both on one portal I'd sign-up.*" Two respondents mentioned that they are "*prudent in water usage already*" and "*very conservative with water use*" respectively. Finally, one participant asked for a better explanation of what is meant by "*detailed water use analysis*" as promoted by the email he received.

Table 6. Effect of portal sign-ups on water consumption

	(1) Water consumption (gallons/day)	(2) Water consumption (gallons/day)	(3) Water consumption (gallons/day)	(4) Water consumption (gallons/day)
Treatment (sending communications)	-0.462	-0.276		
	(-0.22)	(-0.20)		
Signed up to AMI portal			-8.668	-5.171
			(-0.22)	(-0.20)
Constant	136.8***	42.57***	137.1***	42.72***
	(75.63)	(12.37)	(42.96)	(12.11)
Control variable used		X		X
Observations	13124	13085	13124	13085

Notes: This table shows the effects of our main intervention (sending emails to customers) and of signing up for the portal on water consumption. The first two columns show the effect of promoting the portal via email. The second two columns show the effect of signing up for the portal. T statistics in parenthesis. * p<0.1 ** p<0.05 *** p<0.01.

The remaining 11 survey participants indicated their reason for not signing up by choosing from a predefined list. Three respondents did not find the portal useful, three wanted to avoid unwanted communications, two had data privacy concerns. The remaining three participants perceived the offer as irrelevant, did not have time to register, and faced technical issues, respectively.

5.2 Encouraging conservation newsletter sign-up

In this experiment, we worked with Global Water Resources (GWR) to redesign communications that encourage customers to sign up for GWR's water conservation e-newsletter. We randomly assigned customers to groups that received different versions of emails through which behaviorally-informed interventions were delivered. The emails went out to all GWR customers who have AMI installed.

5.2.1 Findings summary

We found that the simple act of sending emails to encourage or remind customers to sign up for a newsletter is very effective in increasing newsletter sign-up rates. Each of the three communication designs we tested had a 8 to 9% sign-up rate.

> In each of the three communication designs we tested, 8 to 9% customers signed up for the conservation newsletter. However, we found no evidence that signing up for the newsletter leads to water savings.

In terms of the effects on water consumption, we found no evidence that signing up for a water conservation newsletter leads to water savings. This may be because a larger sample of customers is required to achieve the sample size needed to detect this type of effect, should any exist. For future studies, it would be helpful to also investigate the level of engagement with the newsletter content for those who signed up. For example, it is important to verify that those who signed up actually ended up receiving, opening, and reading the newsletter.

Overall, this trial shows that behaviorally-informed communications can be used to effectively and positively influence customer behavior. There are many other applications that could be pursued by utilities, such as interventions that encourage the reporting of leaks; promote the timely payment of bills; or improve the understanding of tiered pricing systems. These interventions can and should also be evaluated using randomized controlled trials so that utilities can continue making evidence-based decisions that are informed by robust evidence.

5.2.2 Experimental design

This section describes the experimental design and provides details regarding the behavioral interventions included in the emails. We also provide information on the sample of participants and the spread across treatment groups in this section.

5.2.2.1 Main intervention

At the beginning of the experiment, we randomly assigned one-quarter of the GWR customer base to each of the following groups:

- **Control group:** receives a short email about drought-related information only
- **Treatment group 1:** receives an email about drought-related information, which also promotes conservation and encourages sign-up to the newsletter
- **Treatment group 2:** receives the same email as treatment group 1, with the addition of a ‘commitment statement’
- **Treatment group 3:** receives the same email as treatment group 1, with the addition of an ‘exclusivity statement’

For the main intervention, those assigned to the control group received a short email that provided information on the ongoing drought in Arizona without receiving any behavioral intervention. Treatment group 1 received an email that promotes conservation and encourages them to sign-up to GWR's conservation e-newsletter, in addition to drought-related information.

Figure 25. Vanilla email sent to treatment group 1

Hello [*Name*],

Arizona is currently experiencing a drought, and Colorado River supplies are decreasing.

Based on the current hydrology, it is likely that the US Bureau of Reclamation will announce a Tier 1 shortage level for 2022. A shortage will result in a substantial cut to Arizona's share of the Colorado River. This would primarily affect agricultural users, and **NOT** affect municipal water providers such as Global Water Resources.

Arizona is doing what it can by investing in water infrastructure, supplies, and conservation. **But we would like your help to make sure that the situation does not get worse in the future.**

You can play your part by signing up to our new conservation e-newsletter, which will provide you with advice about how to conserve and continue to use water wisely.

CLICK HERE TO SIGN UP FOR THE CONSERVATION E-NEWSLETTER

Thank you,

[*Staff Name*]
[*Position*]

Treatment group 2 received the same email as treatment group 1, with the addition of a 'commitment statement'. More specifically, we framed signing up for the newsletter as making a commitment to conserving water by adding the question: *"Are you willing to commit to conserving water this summer?"*

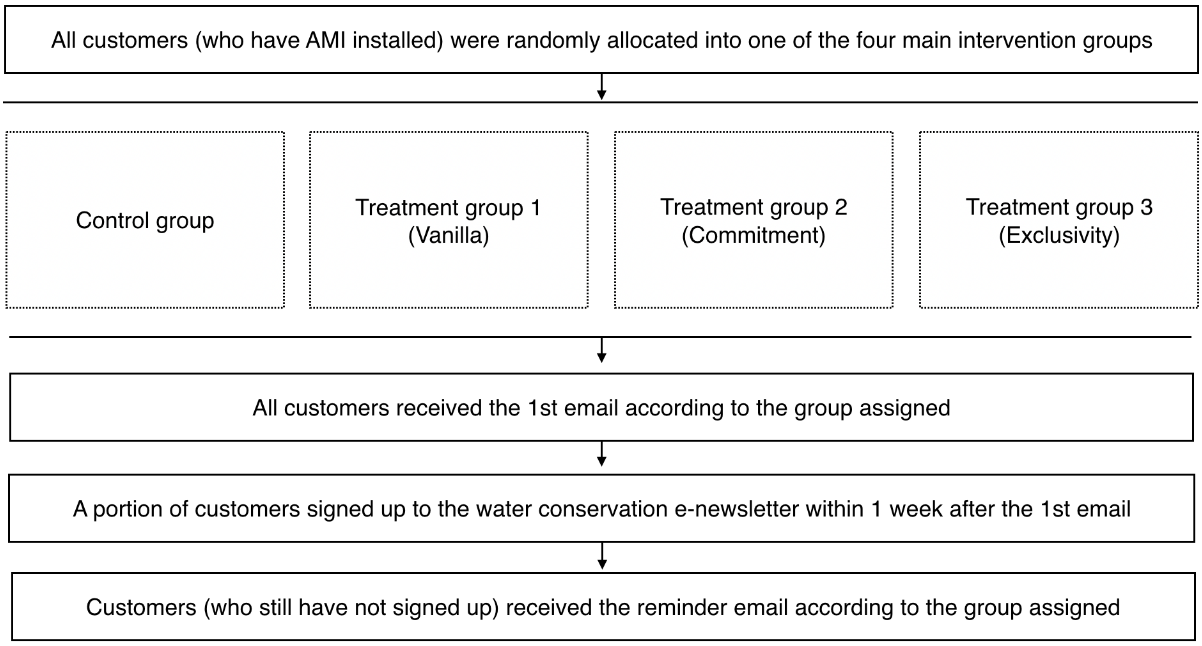
Treatment group 3 also received the same email as Treatment group 1, with the addition of an 'exclusivity statement'. We suggested that the newsletter is part of a new pilot conservation program and that there is limited space available. The statement that was added in the email reads: *"There are limited spaces available. Everyone who signs up will receive an e-newsletter."* As everyone in the treatment groups had the sign-up link included in the email, they can easily complete their sign-ups should they decide to do so.

5.2.2.2 Reminder

To minimize the number of people who did not sign up merely because they forgot to do so, we sent a reminder email one week after the first emails went out. The reminder emails were designed and sent according to the conditions assigned at the beginning of the experiment (e.g., those allocated to treatment group 2 received reminder emails that also included the 'commitment statement' as they did for the main intervention).

Figure 26 illustrates the experimental design of the trial. All of the emails that were sent can be found in the Appendix.

Figure 26. Experimental Design



5.2.2.3 Conservation newsletter

The conservation newsletter was sent via email to registered customers about 2.5 months after the first invite to sign up went out. It contains information about the ongoing drought and smart irrigation controllers as well as water conservation tips including how to reduce outdoor water use. A copy of the newsletter can be found in the Appendix.

5.2.3 Data

This section provides information on data sources and sample sizes.

The data used to randomize the trial participants, and to measure outcomes, come from the following sources:

- Utilities' administrative data (e.g., customer IDs and postcodes)
- CRM data (e.g., whether emails were opened and links included in the email were clicked by participants)
- Water consumption data

Our sample for this experiment consisted of 20,681 individuals.

5.2.4 Results

In this section, we present the results from the trial. Our primary outcomes of interest include:

- Whether customers signed up to the conservation e-newsletter
- Whether customers opened the emails
- Whether customers changed their level of water consumption

5.2.4.1 Effect of interventions on e-newsletter sign-up and email open rates

The two graphs below illustrate the effects of sending utility customers behaviorally-informed communications. Figure 27 plots the share of customers in each intervention group who signed up to the conservation newsletter within 20 days after the interventions were delivered. The figure shows graphically that all emails encouraged newsletter sign-ups, with about 8 to 9% of customers from each group signing up.

Figure 28 plots the cumulative daily sign-ups to the conservation newsletter. As shown in the figure, there were spikes observed for all treatment groups immediately after the main treatment email and the reminder email were sent out on August 10 and August 18 respectively. Interestingly, the spike after the reminder has a steeper slope than that after the main treatment email, suggesting that the reminder is highly effective and could be even more important than the 1st email in getting customers to sign up.

Figure 27. Share of customers who signed up to newsletter by main treatment group

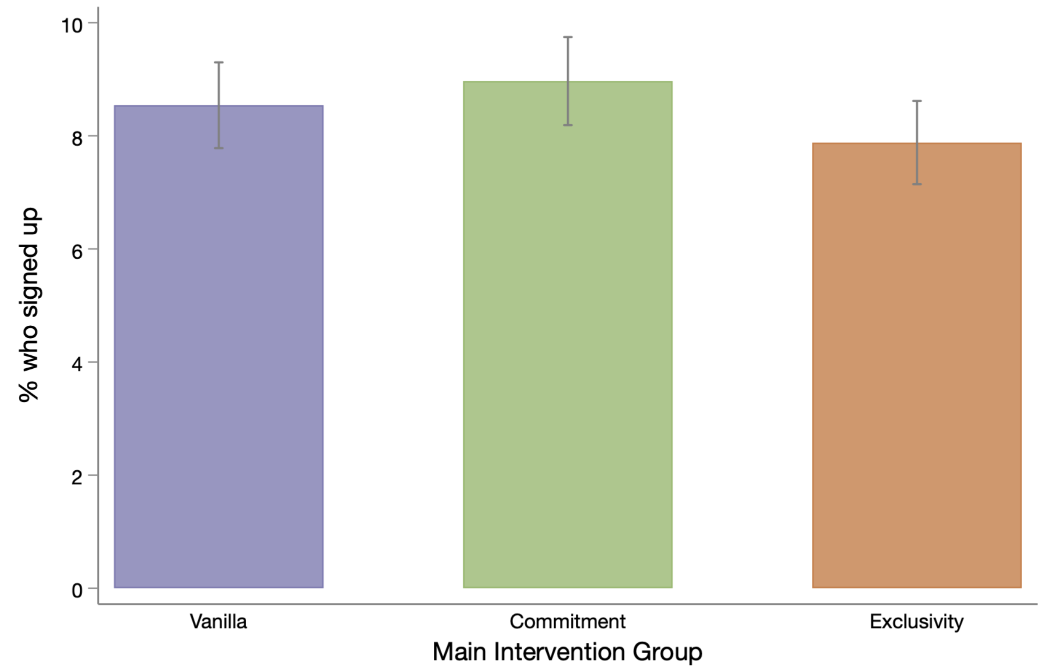
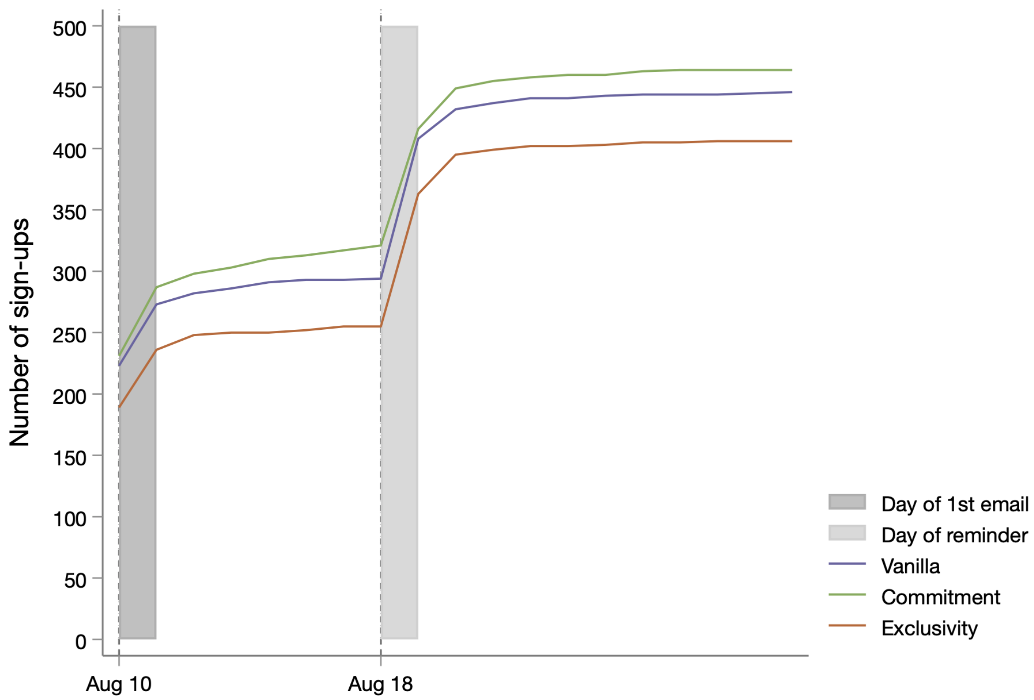


Figure 28. Cumulative daily sign-ups by main treatment group



While all three types of interventions were effective in increasing portal sign-up rates, one may be interested in their relative effectiveness when compared to each other. To assess and identify the intervention that performed better than the others, we conducted an analysis on the comparative effects of different intervention types on e-newsletter sign-up rates and email open rates. As shown in Table 7, we found no significant differences between the three groups. While there is suggestive evidence that the exclusivity treatment is less effective than the others, the differences are not statistically significant (see columns 1, 3, and 5). In other words, they performed equally well in encouraging customers to sign up for conservation e-newsletter and getting customers to open the emails. Importantly, this result also shows that the vanilla email was very well designed and successful as it achieved an overall newsletter sign-up rate of over 8% despite being a simple version of the communication.

Table 7. Comparative effect of the treatment on newsletter sign-up rates and email open rates

	(1) Signed up (overall)	(2) Opened 1st email	(3) Signed up (after 1st email)	(4) Opened reminder	(5) Signed up (after reminder)
Commitment	0.00427	-0.00218	0.00613	0.00981	-0.00179
	(0.77)	(-0.23)	(1.32)	(0.98)	(-0.52)
Exclusivity	-0.00660	-0.00538	-0.00660	0.0141	-0.0000442
	(-1.23)	(-0.58)	(-1.49)	(1.40)	(-0.01)
Constant	0.0854***	0.661***	0.0569***	0.552***	0.0303***
	(22.08)	(100.86)	(17.74)	(77.97)	(12.39)
Observations	15548	15548	15548	14639	14639

Notes: Each cell in the table tells us what the difference in the sign-up rate (in column 1, 3, and 5) or the email open rate (in column 2 and 4) is between the vanilla group and the group represented in that particular row. The only exception is the row representing the vanilla group (i.e., constant), which tells us what the sign-up rate (in column 1, 3, and 5) or the email open rate (in column 2 and 4) was in the vanilla group after the interventions have been delivered. T statistics in parenthesis. * $p<0.1$ ** $p<0.05$ *** $p<0.01$.

5.2.4.2 Effect of signing up for the newsletter on water consumption

While it is certainly encouraging to find that sending simple communications to customers successfully increases newsletter sign-up rates, an interesting question to further examine is whether signing up for the newsletter results in reduced water consumption. To assess the effect of newsletter sign-up on water consumption, we conducted analysis on water consumption data provided by GWR using an instrumental variables (IV) approach. Table 8 shows the effect of signing up for the e-newsletter on average daily water consumption. As shown in the table, we did not find evidence that signing up for the newsletter led to reduced daily water consumption. This may, however, be due to the fact that our analysis involved only the fraction of customers who signed up for the newsletter, as opposed to the entire sample. A smaller sample size generally makes effects harder to detect even if they are present, which might also have been the case in the present study.

Table 8. Effect of e-newsletter sign-ups on average daily water consumption

	(1) Water consumption (gallons/day)	(2) Water consumption (gallons/day)	(3) Water consumption (gallons/day)
Treatment group 1 (Vanilla)	0.484 (0.17)		
Treatment group 2 (Commitment)	1.268 (0.45)		
Treatment group 3 (Exclusivity)	-0.830 (-0.29)		
Treatment (sending communications)		0.309 (0.13)	
Signed up to e-newsletter			3.512 (0.13)
Constant	214.9*** (107.40)	214.9*** (107.40)	214.9*** (106.10)
Observations	18661	18661	18661

Notes: This table shows the effects of our main intervention (sending emails to customers) and of signing up for the newsletter on average daily water consumption. The first column shows the effect of each treatment email while the second column shows the overall effect of promoting the newsletter using email communications. The third column shows the effect of actually signing up for the newsletter. T statistics in parenthesis. * p<0.1 ** p<0.05 *** p<0.01.

To confirm the null results, we conducted further analysis to assess the effect of signing up for the newsletter on total water consumption over different periods of time after the newsletter has been delivered. As shown in Table 9, we also found no statistically significant results either with total water consumption over different time periods.

Table 9. Effect of e-newsletter sign-ups on total water consumption over different periods of time

	Water consumption (gallons)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Over 1 week 1	Over 1 week	Over 2 weeks	Over 2 weeks	Over 3 weeks	Over 3 weeks	Over 4 weeks	Over 4 weeks
Treatment (sending communications)	-8.358		-3.383		6.027		12.76	
	(-0.44)		(-0.10)		(0.12)		(0.19)	
Signed up to e-newsletter		-94.69		-38.32		68.28		144.5
		(-0.44)		(-0.10)		(0.12)		(0.19)
Constant	1542.7***	1542.8***	3055.6***	3055.6***	4554.7***	4554.6***	6040.4***	6040.2***
	(94.47)	(93.25)	(99.22)	(97.93)	(102.08)	(100.74)	(104.32)	(102.95)
Observations	17163	17163	17163	17163	17163	17163	17163	17163

Notes: This table shows the effects of our main intervention (sending emails to customers) and of signing up for the newsletter on total water consumption at different periods of time after the newsletter has been delivered. Columns 1, 3, 5, and 7 show the overall effect of promoting the newsletter via email on water consumption during the 1, 2, 3, and 4 weeks after the delivery of the newsletter respectively. Columns 2, 4, 6, and 8 show the effect of signing up for the newsletter on water consumption during the 1, 2, 3, and 4 weeks after the delivery of the newsletter respectively. T statistics in parenthesis. * p<0.1 ** p<0.05 *** p<0.01.

06 Conclusion

This report presents the results from a national utility survey, interviews with utility managers, and four field experiments that focused on answering two main questions: 1) Can AMI portals promote water conservation in the residential sector? and 2) How can utilities improve the efficacy of AMI portals—both in terms of increasing AMI portal uptake and portal engagement?

We find suggestive evidence that AMI portals can help customers save water. Specifically, our trial showed that registering in the portal led to an average decrease in daily water usage in the range of 5 to 9 gallons. Although this finding should be interpreted as indicative and more evidence is needed before we can arrive at a firm conclusion, it does correspond to the 2-10% water savings range documented by other (mostly correlational) studies in the existing literature.

The ability of AMI portals to produce water savings depends on how successful utilities are in motivating customers to sign up for the portal. We find that 79% of utilities are very or extremely confident that AMI provides benefits to their customers. However, our interviews reveal that many utilities struggle in convincing customers to sign up for the AMI portal. One of the reasons is that customers need to overcome several behavioral frictions, such as the complexity of the sign-up process, that impede the portal uptake. Furthermore, utilities need to maintain the engagement of registered customers with the AMI portal over time in order to maximize the portal's ability to promote water conservation.

> We show that agencies can apply behavioral techniques to increase the uptake of, and engagement with, AMI portals. Our trials specifically demonstrate that sending a simple email about the benefits of the AMI portal and following up with a reminder can increase the number of sign-ups two-fold or more.

Further, we underline the importance of adopting an experimental approach to realize the full potential of AMI portals. Utilities should systematically pilot different interventions aimed to improve portal engagement, rather than immediately roll out new AMI communications and features in full. Piloting the interventions through experimental trials enables agencies to better understand what works and adopt an effective 'test, learn, and adapt' approach to optimize their operations and achieve their targets.

Our study outlines a number of future directions. First, the field needs more causal evidence on the efficacy of AMI portals in producing water savings. While our trials have contributed to such evidence, more experimental research is needed to determine under which conditions, and to what extent, AMI portals produce water savings. Second, more investigation is needed to understand how utilities can maintain customer engagement with AMI portals over time. One particular domain that deserves further investigation is whether providing symbolic rewards and financial incentives via the portal can promote its continuous use.

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08 Appendix

8.1 Literature review tables

Table A1: Literature summary on increasing engagement with AMI

Name	Study type	Involves AMI	Water or Electricity	Behavioral intervention used	Findings
Abrahamse et al., 2006	meta-analysis /sys-review	no	both	N/A	Reviewed and classified behavioural strategies based on 38 studies on encouraging home energy conservation. Goal setting, commitment and feedback seem to be particularly effective.
Allcott and Rogers, 2014	RCT	no	electricity	social norms	The study examined the long-term effect of social comparisons on energy conservation. It found that the effect of social comparisons persisted even after the home energy reports didn't contain the social comparison element anymore. The decay in effectiveness was 10-20 % per year.
Allcott, 2011	RCT	no	electricity	social norms	Social comparisons as part of home energy reports produced 2% electricity savings on average.
Alskaif et al., 2018	theoretical	yes	electricity	N/A	Proposes the use of gamification to engage residential customers in taking an active role in energy applications enabled by smart meters and presents a compilation of the most commonly used game design elements based on the various literature and projects in this area. Five main elements identified are information provision, rewarding system, social connection, user interface, and performance status.
Andor and Fels, 2018	meta-analysis /sys-review	no	both	N/A	Most causal studies in the energy conservation domain used social comparison, goal setting, commitments or labelling. Social norms generally work, however, have a lower effect for households that consume little energy. Goal setting is in the need of more robust research. It works best when goals are set to be around 10%, externally set and with people who are motivated to save. (“People who are in general more motivated to conserve energy could have selected themselves into more realistic goals, while people who are generally unwilling to change their behavior chose zero.”). Self-set goals seem to result in a significant reduction effect when they are chosen realistically. Labelling is effective in affecting consumer’s willingness to pay for ecological products.

Asensio and Delmas, 2016	RCT	yes	electricity	feedback; framing	A randomized controlled trial finds that tailored information disclosures about the environmental and health implications of household electricity use can be very salient with residential consumers and lead to more lasting behavioral effects versus framing based on cost saving. The use of a health-based frame, in which households consider the human health effects of their marginal electricity use, induced persistent energy savings behavior of 8–10% over 100 days. A a more traditional cost savings frame, drove sharp attenuation of treatment effects after 2 weeks with no significant savings versus control after 7 weeks.
Baddeley, 2016	theoretical	yes	both	N/A	The behavioral factors that are likely to be most significant for smart meters include status quo and familiarity biases, anchoring and adjustment around reference points, social influences, and present bias/short-termism. The review also explores the potential for smart meters to effectively enable household energy saving – for example, by providing a tool for setting default options, allowing more frequent and accurate real-time energy use data for householders, conveying social information and/or improving information flows, and enabling householders to switch suppliers more easily.
Bager and Mundaca, 2017	RCT	yes	electricity	feedback; framing	The pilot study explored to what extent loss-framed and salient information about electricity use via smart meters has the potential to induce household energy conservation. Results suggest that how smart meter information is presented to households has an impact on how the feedback is perceived and acted upon.
Battala-Bejerano et al., 2020	meta-analysis /sys-review	yes	electricity	N/A	Based on the results of the review, it is apparent that continuous energy information feedback may well be an effective driver of energy-related behavior change. While energy cost information is clearly relevant, providing consumers with specific, tailored, and scientifically verifiable information about the associated environmental and health effects of their energy consumption can have a stronger and more persistent influence on a consumer's daily electricity use.
Beal et al., 2016	other empirical	yes	water	feedback; social norms	The study found that applying feedback and social norms can reduce peak hour water consumption, in some cases up to a third of the total consumption.
Bertoldi, 2016	meta-analysis /sys-review	yes	electricity	N/A	"There are relevant uncertainties from the literature and significant gaps still remain in our knowledge of the effectiveness and cost benefit of feedback. In particular: • the effect of feedback on consumers in different social and demographic groups; • the effect of feedback on appliance purchasing decisions; • whether feedback continues to work over time or whether it needs to be renewed/reshaped to keep householders engaged and maintain any conservation effects. • the ability for feedback to facilitate the sharing of energy information between households, friends or neighbours is almost entirely unexplored; • the divergence of cost-benefit calculations for

					feedback with advanced metering infrastructure needs to be explored as does the conditions under which the costs of feedback outweigh the benefits."
Brent et al., 2015	RCT	no	water	social norms; personalization; feedback; incentives-financial	In two out of three water utilities, social comparisons were found to be effective in reducing water consumption (by 5%). Treatment effects are largest for high-use households (more likely to be more responsive because they have more flexibility to reduce consumption and have the potential to achieve greater financial gains from conservation). No statistically significant treatment effect for the third utility, possibly because its rate structure already provides very strong incentives for conservation and reports were emailed rather than mailed.
Buchanan et al., 2016	other empirical	yes	electricity	N/A	In terms of consumer perception of smart meters, threats identified include autonomy issues, privacy concerns, and mistrust of suppliers, while opportunities identified include avoiding the hassles of meter readings, more accurate billings, the chance to reduce energy bills, and the enablement of future smart-meter services (including text alerts and smarter controls that would allow consumer to switch off ‘unused’ appliances remotely) and automated energy management.
Bugden and Stenman, 2019	other empirical	yes	both	N/A	A survey (N = 609) of homeowners in Ithaca, New York who are part of an upcoming smart meter roll-out. Familiarity and climate change risk perceptions have the greatest effect on smart meter acceptance. Smart meter acceptance, lower age, and higher income have the strongest effect on engagement.
Burchell et al., 2016	other empirical	yes	electricity	feedback; personalization; social norms	Two elements of the Smart Communities approach appear to have together been important in facilitating long term changes and prompting and prolonging engagement with energy consumption monitoring and feedback: the community action context and the prompts to action in the weekly emails. The qualitative research suggests that key to these encouraging outcomes was the relationship that developed between the Smart Communities project (and the individuals running it) and its members. This seems to have created an important sense of commitment and reciprocity and a feeling among many members of ‘being part of something’. Project members variously implied that ‘being part of’: an energy project, a community project, a school community or initiative, a university/research project, or more straightforwardly a local interesting social group – was important to them. In some cases, the sense of ‘being part of something’ was developed through personal interactions. However, it was even reflected on by participants in the absence of attendance of the more interactive community events. The data suggests that – for far more project members – the weekly Smart Communities emails in conjunction with the community action context played a vital role in this.

Carmichael et al., 2021	theoretical	yes	both	N/A	A number of recommendations are put forward for accelerating UK consumer engagement , including: (a) promote awareness of smart tariffs, smart meters and storage and automation behind-the-meter devices as mutually-supportive components within a common 'Demand Response technology cluster' and (b) enable and support informed adoption of Demand Response-enabling products and services through 'smarter' digital comparison tools (DCTs), data portability, and faster, simpler switching. However, while the interdependency between components within the Demand Response technology cluster delivers efficiency, it also poses ses risk that one delayed component (e.g., smart metering) will hold up policy and industry support for other components.
Carroll et al., 2014	RCT	yes	electricity	feedback	The study finds that participation in a smart metering programme with time-of-use tariffs significantly reduces demand. While treated households also increased their self-reported energy-reducing information, such improvements are not correlated with demand reductions in the short-run. Given this result, it is possible that feedback and other information provided in the context of smart metering are mainly effective in reducing and shifting demand because they act as a reminder and motivator. In summary, the study finds no evidence that informational improvements per se were necessary or sufficient for reducing electricity demand.
Castro et al., 2020	other empirical	yes	both	N/A	Highlights the importance of three variables: households' existing type source of power, presence of individual water control, and type of type of gas supply. Similar to the type of power source, when households do not have water control devices already installed, smart meter configuration costs increase considerably. This is because flow sensors need to be installed at every water entry point. Also, all tenants living in dwellings without individual water control pay equal amounts for water usage in units regardless of their individual usage, which increases the number of unsatisfied customers.
Chatzigeorgiou and Andreou, 2021	meta-analysis /sys-review	yes	electricity	feedback	An average effect size of feedback strategies on energy saving behaviour cannot be extracted. The systematic review claims that there is a trend in moving feedback from IHDs to mobile devices.

Chen et al., 2017	other empirical	yes	both	N/A	Consistent with previous studies conducted in Korea and Germany, perceived usefulness was a positive predictor of smart meter adoption intention. The magnitude of the influence of usefulness in the study suggest that successful efforts to enhance such perceptions could significantly increase smart meter adoption in the U.S. In addition, perceived usefulness was the strongest mediator: the relationships among trust, problem perception, and smart meter support and adoption intention cannot be well explained without considering perceived usefulness. In addition, perceived privacy risk was negatively associated with acceptance of smart meters, indicating a need to address privacy concerns in order to increase adoption. Interestingly, participants generally trusted their utilities, but were fairly concerned with unauthorized third parties' misuse of data or personal information. It is recommended that utilities widely publicize procedures for data recording, storage and protection prior to implementation.
Cominola et al., 2021	other empirical	yes	water	feedback; other	Presents quantitative evidence that durable household water conservation behaviors can be observed in the presence of consumption feedback informed by smart meter data and user engagement mediated by a digital platform providing data visualization and interpretation, recommendations for water saving, and a gamification program. More than half (nearly 58%) of the households in the treatment group achieved substantial water savings in the short term. Almost half (47%) of all households in the treatment group also preserved durable water conservation behaviors two years after the start of the treatment. Also observes more frequent conservation behaviors for households that received smart meter information with hourly sampling frequency, rather than daily, suggesting that the availability of high-frequency consumption data appears to be a prerequisite for an effective digital engagement of water users
Darby 2010	meta-analysis /sys-review	yes	electricity	N/A	The qualitative research cited shows interest in, and even enthusiasm for, simple and direct messages about energy costs over time, and for relevant, trustworthy comparisons
Datta et al., 2015	RCT	no	water	social norms; feedback; goal-setting	Social norm intervention reduces water consumption by 3.7-5.6%, and plan-making intervention reduces consumption by 3.4-5.6%. While the two interventions have similar results, they are effective on different sub-populations, with the plan-making intervention being most effective on low-consumption households while the social norm intervention is most effective on high-consumption households.
Davies et al., 2014	RCT	yes	water	feedback	Households with in-home display (IHD) installed reduced their water consumption by an average of over 6.8% over the 5 year study period when compared to the control group. Water consumption data collected over the 3 year post-trial period revealed that the treatment group consumed 6.4% per month less water when compared to the pre-trial period, whilst the matched control group

					consumed 1.3% per month more water when compared to the pre-trial period. The reduced consumption of the treatment group was maintained over time, demonstrating the long-term value of the Smart Metering technology in helping households reduce water consumption.
De Dominics et al., 2019	RCT	yes	electricity	social norms	When framed as a social comparison, feedback resulted in long-term reductions in household electricity consumption. Importantly, greater reductions were observed for households that identified more strongly with the normative reference group.
Delmas et al., 2013	meta-analysis /sys-review	no	both	social norms; personalizati on; feedback; incentives	"Our results also show that strategies providing individualized audits and consulting are comparatively more effective for conservation behavior than strategies that provide historical, peer comparison energy feedback. Interestingly, we find that pecuniary feedback and incentives lead to a relative increase in energy usage rather than induce conservation. Low involvement information-based strategies, i.e. energy saving tips, are not effective at reducing energy use, while high involvement information strategies, i. e. home energy audits and consulting, do support our hypothesis that non-price information strategies can lead to favorable energy use reductions. While most energy savings tips are provided either in billing or website data, these results suggest that simply providing energy saving tips does not sufficiently motivate subjects to conserve."
Ehrhardt-Martin ez et al., 2010	meta-analysis /sys-review	yes	electricity	N/A	The most effective forms of feedback are likely to include both products and services that provide consumers with a combination of detailed, frequent, and ongoing consumption information as well as a meaningful context within which to interpret the information, a variety of motivational tools, and tailored suggestions for reducing consumption. Importantly, participation rates are significantly higher for programs using an opt-out (as opposed to opt-in) design.
Erickson et al., 2012	other empirical	yes	water	feedback; social norms; other	Conducted a 16-week trial with 303 volunteer households who were provided with an access to a portal. Out of the surveyed households, 45% reported a change in their water consumption behavior as a result of using the portal and 39% made a change to their existing water infrastructure (most frequently fixing the leaks). Overall, 61% of portal users reported to make changes to their water use patterns or water appliances during the pilot.
Erickson et al., 2013	other empirical	yes	electricity	incentives; social	A 20-week pilot that tested an electricity consumption portal with 765 volunteers. It enabled us to set goals, provided incentives and showed social comparisons. In response, the households

				norms; goal setting	reduced their electricity consumption by 3.7% on average. They reported both changes in behavior and upgrading the electricity infrastructure.
Ferraro and Price, 2013	RCT	no	water	social norms; feedback	Social comparison messages had a greater influence on behavior than simple prosocial messages or technical information alone. Social comparison messages are also most effective among high-consuming households. However, the effectiveness of such messages wanes over time.
Ferraro et al., 2011	RCT	no	water	social norms; feedback	The study found that social comparisons work better than prosocial appeals in the long run: while both strategies affect short-run water use, only social comparisons have a lasting impact. Within a year of the intervention, no treatment effect was detected for households that received prosocial appeals. In contrast, impacts from the social comparison treatment can be detected more than two years after the intervention.
Fielding et al., 2012	RCT	yes	water	feedback; social norms; personalizati on	Informational postcards with either general advice about how to save water or the numbers of other “low water use households” that performed water-saving behaviors resulted in water savings quite rapidly, but the changes were lost over time, as households later returned to their pre-intervention water use levels. Water use declined more slowly for those who received feedback on their own household’s water use but the effect was longer-lived.
Fischer, 2008	theoretical	no	electricity	feedback	The most successful feedback is given frequently and over a long time, provides an appliance-specific breakdown, is presented in a clear and appealing way, and uses computerized and interactive tools.
Galli et al., 2015	theoretical	yes	water	N/A	Proposes a gamified application to enhance users' participation and data collection in regards to AMI portals by describing the design principles and the architecture of an envisioned solution. An integrated approach exploiting both board and digital games to incentivize users to submit meaningful data for water utilities and change their long-term behavior is also detailed.
Gangale et al., 2013	other empirical	yes	electricity	N/A	Two most frequently referred to as critical challenges in improving engagement are (i) lack of trust by consumers, and (ii) uncertainties regarding the use of different motivational factors (taking into consideration different consumer segments). Motivational factors commonly used by smart grid projects in Europe are: (i) the reduction of/control over electricity bills; (ii) environmental concerns, and (iii) better comfort, i.e. the provision of technological solutions allowing the optimisation of comfort and more control over own energy use. Most of the projects reviewed in the study actually combine more than one motivational factor, usually environmental concerns and reduction of electricity bills. This result highlights the fact that electricity providers are not yet targeting single

					consumer segments, but are approaching consumers as a whole, trying to appeal to them with a combination of different motivational factors.
Geelen et al., 2019	RCT	yes	electricity	feedback	The trial provided users with an app that tracked their energy consumption in real time. This feedback itself did not produce any significant savings. It is important to provide actionable and personalized tips together with the feedback.
Gimpel et al., 2020	meta-analysis /sys-review	yes	both	N/A	A meta-analysis identifies Attitude and Performance Expectancy as the primary determinants of individuals' smart energy technology adoption. Further, results show that Environmental Concern influences all other determinants.
Gold et al., 2020	meta-analysis /sys-review	yes	electricity	N/A	Some strategies include incentives, normative reporting, and personalization of information and messaging. To have the greatest impact, energy use feedback should be coupled with programs, services, and pricing that can motivate, assist, and reward customers for taking actions. In a pilot AMI program, CenterPoint Energy used a web portal to provide smart-meter customers with information on how to better manage their energy usage and costs, including education on steps to reduce peak demand. The pilot included prizes for successful responses. In 2011 the set of 198 participants reduced peak demand by an average of 5% during 10 events; some participants reduced consumption by as much as 35% (DOE 2016). Mobile applications are another way for utilities to provide feedback and can be an effective tool to engage customers. For example, DTE's behavior program uses a mobile application, Powerley, that gives customers energy usage insights and allows customers to set savings targets, interact with feedback tools, and see recommendations of energy efficiency measures targeted to their consumption patterns. Customers can request an Energy Bridge that uses AMI to collect one-minute energy usage information and gives customers real-time energy usage feedback through the DTE Insight app. Paired with home energy reports, in 2018 DTE's residential behavior change programs achieved 62.7 GWh of energy savings and reduced demand by 23.6 MW (DTE Electric Company 2019).
Guerreiro et al., 2015	other empirical	yes	electricity	N/A	Smart meter use is influenced by subjective norms, perceived utility, health-related risk perception, procedural justice, and time of usage. In a second study, internet blogs discussing smart meters were analyzed. This study corroborated some of the results of the first study and suggested additional factors—such as perceived distributive injustice and loss of control and privacy-related risk perception—that may influence the use of smart meters.
Hahn et al., 2016	RCT	no	water	social norms;	By themselves, social comparisons and loss framing have no significant impact on the number of rebate requests (for replacing lawn with drought-resistant plants); when combined, however, they

				feedback; framing	lead to a 36% increase in requests. Only loss framing leads to a significant increase in the purchase of drought-resistant plants, and only social comparison reduces water consumption.
Handgraff et al., 2013	RCT	no	electricity	incentives-financial; incentives-symbolic	The study measured electricity use for 13 weeks at a Dutch firm. Each week, employees were rewarded for conserving energy, receiving either monetary rewards (€0–€5) or social rewards (grade points with a descriptive comment), and privately or publicly. In both the short and long term, public rewards outperformed private rewards, and social rewards outperformed monetary rewards. The results suggest that private monetary rewards, although popular, may be ineffective. Instead, public social rewards may be a more promising approach to stimulating energy conservation.
Harding and Hsiaw, 2014	other empirical	yes	electricity	goal setting	Households were more likely to sign-up for AMI portal if they were more educated, younger, and concerned about the environment. When consumers set energy savings goal that were realistic, they were able to save much more energy (11%) compared to the average of the sample (4%).
Hargreaves et al., 2010	other empirical	yes	both	feedback; goal setting	The information provided by smart energy monitors needs to be clear, transparent and flexible (i.e. presentable in a variety of formats and perhaps customisable) so that it can be easily related to everyday practices and contextualized. Efforts should be made to address whole households rather than simply individual householders, and the wider policy and business context should be seen as supportive of householders' efforts.
Hartley et al., 2021	theoretical	yes	water	N/A	The article argues that digital feedback capabilities must focus on multi-modality, maintain user-friendliness, account for appropriate timing to highlight links with opportunities for behavior change, and leverage positive messaging where most effective. It also emphasizes the use of personalization, commitment, and integration of technical systems and media platform as strategies
Hartman and LeBlanc, 2014	meta-analysis /sys-review	yes	electricity	N/A	The key to customer engagement with AMI platforms is presenting information effectively using portals that are compelling, actionable, and available to people on the communications channels they prefer to use
Henn et al., 2019	other empirical	yes	electricity	feedback	A quasi-experiment finds that registering for a web portal that provided smart-meter-based feedback led to moderate energy savings conditional on a person's environmental attitude level.

Jessoe and Rapson, 2014	RCT	yes	electricity	feedback	Using a randomized control trial, the study tests the effect of high-frequency information about residential electricity usage on the price elasticity of demand. Informed households are three standard deviations more responsive to temporary price increases, an effect that is not attributable to price salience. Conservation extends beyond pricing events in the short and medium run, providing evidence of habit formation and implying that the intervention leads to greenhouse gas abatement.
Jessoe et al., 2021	RCT	yes	both	feedback; social norms; personalization	The study finds that water consumption feedback induce conservation beyond the water sector, leading to a 1.3 to 2.2% reduction in summertime electricity use. An engineering simulation suggests that complementarities between appliances that use water and electricity can explain only 26% of the electricity reduction. Incorporating the cross-sectoral spillover increases the cost-effectiveness of the intervention by 62%
Joachim et al., 2011	other empirical	yes	electricity	feedback	Feedback on electricity consumption via web portal or mail leads to an average electricity savings of about 3.7% (which translate into annual energy cost savings of around €30 for the average household)
Koo et al., 2015	other empirical	yes	both	N/A	Intrinsic motivations (perceived enjoyment) and extrinsic motivations (saving money and legislative pressure) significantly correlate to the perceived usefulness of smart green IT devices. Perceived usefulness is found to strongly impact the continued use of a smart green IT device
Koop et al., 2019	theoretical	no	water	N/A	The paper provides an overview of the current state of the literature on influencing domestic water conservation behavior. Eight key Behaviour Influencing Tactics (BITs) are identified: knowledge transfer, self-efficacy, social norms, framing, tailoring, emotional shortcuts, priming, and nudging.
Kranz and Picot, 2012	other empirical	yes	electricity	N/A	Highlights perceived usefulness, perceived ease of use, energy price consciousness, and environmental concerns as predictors of consumers intention to adopt smart metering technology
Krishnamurti et al., 2012	other empirical	yes	electricity	N/A	Consumers mostly desire smart meters, but for reasons reflecting mostly unrealistic expectations of their benefits and a lack of understanding of why they are being installed. Those opposed to smart meters had potentially realistic fears regarding threats to their privacy and loss of control. Utilities can address misconceptions about the benefits of smart meters in two ways. One is to scale back the expectations, so that consumers do not expect more than smart meters can deliver. The second is to bring implementation of the technology in line with expectations, by adding useful smart thermostats and in-home displays to show consumers their real-time electricity use and help them to save money.

Liu and Mukheibir, 2018	meta-analysis /sys-review	yes	water	N/A	Online portal uptake generally ranges from 30 to 45%. From those who login for the first time, 40% never log in on the second time. Competitions and incentives can be used to encourage sign-ups.
Liu et al., 2015	other empirical	no	water	N/A	Survey study sample rated end-use metrics as useful, with general preferences towards volumes rather than durations or rates of water uses. Regarding comparisons, there was greater interest and responsiveness to historical self-comparisons than normative ones. For normative comparisons, local references (i.e. own street or suburb) were preferred, together with a variety of benchmarks (efficient and average). Most householders preferred additional interpretations of feedback to include customised water-saving tips. Recommendations from water utilities were more highly valued than advice about what other households are doing to save. Preferences varied highly between different communications mediums, though an enhanced water bill was popular among the majority. Expectations in terms of speed of information communications also varied considerably. Beyond the detection of overall trends in feedback preferences, the survey results showed additionally that the study sample had more similar views on some dimensions of water-use feedback (e.g. interest in historical comparison with the same last year; and both detailed usage information and customised tips); but wider heterogeneity in most responses (e.g. preferred length of historical comparison; preferred normative comparisons e.g. interest in efficient benchmarks; additional interest in specific end-use metrics; most preferred medium; expectations for feedback speed; use of metaphors etc.). These results show that householders are not only heterogeneous in terms of their water consumption patterns, but also very much heterogeneous in their preferences for water-use information.
Liu et al., 2016	other empirical	yes	water	feedback; social norms; personalization	The study finds that detailed household-specific water consumption feedback (including end-use breakdown, social comparison, end-use metrics and customized tips) was well received by participating households. Awareness of water use increased among those receiving the feedback and many reported behavior changes.
Liu et al., 2017	RCT	yes	water	feedback; social norms; commitment; reminder/prompt	The intervention group saved an overall average of 24.1 liters per household per day (L/hh/d) (4.2%). Using the portal was a key predictor of water savings. Leak alerts functionality was popular with portal users - when offered through the portal, 78% signed up for the leak alerts (via SMS or emails). Another popular function was alerting users when 80% of their self-determined water budget was consumed. Portal uptake was 30% among the customers assigned to the experimental group.

Mack et al., 2019	RCT	yes	electricity	feedback; committment; goal setting	User interaction with a smart meter web portal was analyzed and the effect of portal usage on electricity consumption was evaluated. The design of the portal focused on prompting commitment to saving tips and supporting their implementation. Users that committed themselves to at least one saving tip were higher in pre-baseline goal intention than users that did not. The act of committing to saving tips, together with continued self-monitoring of the process of tip implementation, was predictive of a significant saving effect. For motivated users, techniques inducing commitment to action and guiding towards implementation of the action plan seem effective in generating electricity savings.
Makropoulos et al., 2014	other empirical	yes	water	feedback; personalization	The paper describes a pilot development of an online water portal with behavioral features - the household analytics platform enables end-users to monitor their water consumption, in real-time, using a variety of data visualization methods (e.g. dynamic charts, reports, overview tables etc.) and at the same time, receive warnings when leakages or other abnormal patterns are observed; it is further supported by an eLearning platform that helps users improve their domestic water consumption following a multistage educational process, supported by advanced water calculators that allow planning of water saving interventions.
McCoy and Lyons, 2016	RCT	yes	electricity	feedback	The study finds that exposure to time-of-use pricing and information stimuli, while reducing overall and peak usage, can also have the unintended effect of reducing investment in energy efficiency measures within the home. The findings indicate that households exposed to treatment were less likely to adopt any energy saving measure (23–28 % on average), and those households adopted less energy saving features than those in the control group (15–21 % on average).
Moreno-Munoz et al., 2016	meta-analysis /sys-review	yes	electricity	N/A	Promotes the use of mobile social media technologies as an engagement strategy, with a focus on 4 key aspects: personalization (making the client feel special to promote loyalty); exclusivity (rewarding loyal customers with access, information and exclusive offers); mobile apps (having apps is becoming a need nowadays and apps offer a connection anytime, anywhere with the customer, an open line for bidirectional communication and to send the customer contents of any marketing action carried out); and gamification (rewarding customers for their collaboration in the diffusion of a brand or a product. Customer actions such as "likes" or "follows" can be rewarded with exclusive offers).
Nachreiner et al., 2015	theoretical	yes	electricity	N/A	The paper presents a psychological model of self-regulated behavior change that covers the complete process by which new types of behavior are chosen and implemented, and discusses different behavioral stages and components crucial for the design of information strategies.

Nilsson et al., 2018a	RCT	yes	both	feedback	Saving money and protecting the environment were two main motives mentioned by 12 households participating in a smart meter trial and a subsequent in-depth interview. Compared to electricity consumption in kWh, water consumption in L was easily understandable to users. Smaller households compared to families were able to conserve more. Users engaged with smart displays a lot in the first weeks/months but then their interest dropped.
Novak et al., 2018	other empirical	yes	water	feedback; goal setting; incentives-financial; incentives-symbolic	Discusses the design of the behavioral change and incentive model combining smart meter data with consumption visualization and gamified incentive mechanisms to stimulate water saving. Implemented in the SmartH2O system and deployed in two pilots, preliminary results for the Swiss pilot indicate reduced water consumption, positive user feedback and overall suitability of the designed incentive model.
OFGEM, 2011	RCT	yes	electricity	feedback	In a smart meter pilot roll-out by SSE utility (UK), only 50% of respondents in smart meter groups were aware of the portal and only 9% used it. Out of the 9%, only 20% of portal users used it once a month.
Oltra et al., 2013	other empirical	yes	electricity	feedback	Three motivations are identified for not using in-home displays: (i) not being able to understand the numbers in the display; (ii) the display does not provide relevant information; (iii) it is difficult to achieve further savings.
Park et al., 2014	other empirical	yes	electricity	N/A	Results confirmed the importance of consumer education and public relations of the smart grid. One 'shortcut' to ensure the acceptance of the smart grid is to mitigate the anxiety about the risk in the use of the smart grid.
Rausser et al., 2017	other empirical	yes	both	N/A	In order to be attractive for an average consumer, autonomic systems and smart grids of the future need to be more appealing in an economic sense. The consumers in the trial are, in general, more interested in maximizing their own profit and are only concerned about changing the way of using electricity if it means direct monetary benefits and personal gains.
Rettie et al., 2014	RCT; other empirical	yes	electricity	feedback; social norms	Argues that it is important to provide feedback in terms of activities rather than energy units, which have little relevance to householders, and that emphasizing the avoidance of waste could help to make energy consumption visible and prompt changes in energy consuming behaviors.
Rettie et al., 2016	other empirical	yes	electricity	social norms; feedback	The paper reviews two energy feedback studies. It argues that it is important to provide feedback in terms of activities rather than energy units (which have little relevance to householders) and that emphasizing the avoidance of waste could help to make energy consumption visible and prompt

					changes in energy consuming behaviors. Social norms approach is found to be significantly more engaging.
Rizzoli et al., 2018	theoretical	yes	water	N/A	Summarizes the SmartH2O platform (a software platform that creates a virtuous feedback cycle between water users and the utilities, providing users information on their consumption in quasi real time, and thus enabling water utilities to plan and implement strategies to reduce/reallocate water consumption) which adopts a gamification approach to motivate users to change their water use behavior and uses different incentives (virtual, physical, and social) to stimulate competition among users. It has been observed an average reduction in consumption of 10% in Switzerland and of 20% in Spain among the platform adopters.
Schleich et al., 2017	RCT	yes	electricity	feedback	Providing feedback - either via web portals or post - reduced energy consumption by 5%. The effect persisted over 11 months.
Schuitema et al., 2017	theoretical	yes	both	N/A	It was suggested that to create a long-term learning effect, consumers need help in interpreting their energy consumption and frequent reminders, which can be accomplished by adding information on the consequences of their consumption (e.g., financial consequences or carbon footprint). Also, combining energy consumption with feedback about one's own historical energy use, others' energy use (e.g., neighbors or "similar" consumers) can be effective. It is also crucial that consumers trust both the information and the provider of it if this technique is to have any effect. In terms of barriers to investment in technologies, the perceived effort to install and use new technologies influences consumers' investment behavior as well. Consumers tend to be uncertain whether their investments will pay off and whether the adoption of flexibility-enhancing technologies (such as smart meters) will really reduce their energy bills. The theory of the diffusion of innovations suggests that social influence is important for the adoption of technologies: the more people who have adopted a certain technology, the more likely it is that others will do so as well due to a neighboring effect.
Schultz et al., 2014	RCT	yes	water	social norms	Adding descriptive norms led to 26% water savings. Adding injunctive norms (smileys) led to 16% savings. Water saving tips per se didn't produce any changes in water consumption.
Sonderlund et al., 2014	meta-analysis /sys-review	yes	water	N/A	Consumption feedback is most effective when it (1) is delivered at the point of use (e.g. in the form of attunement labels or ambient light displays); (2) includes high-granular time-series data of cost and consumption, social and historical consumption comparisons, as well as appliance-level feedback; (3) is tailored to the household (particularly in terms of high- vs. low-users); and (4) is delivered with water saving advice, detailing how to use feedback to reduce consumption

Sonderlund et al., 2016	theoretical	yes	water	N/A	The provision of more detailed, frequent, and immediate consumption feedback is most effective. 17 of 21 studies reviewed reported a positive effect on water consumption - reductions between 2.5 and 28.6%, with an average of 12.15%
Sovacool et al., 2017	meta-analysis /sys-review	yes	electricity	N/A	One major dimension of obstacles highlighted relates to the exacerbation of vulnerability among some classes of customers—notably burdens upon the elderly, the ill, the less educated, those in social housing, and/or those in rural areas—and a preference for economic competition and cost savings for suppliers and companies, not households
Sussman and Chikumbo, 2016	meta-analysis /sys-review	yes	both	N/A	AMI platforms should aim to change habits (disrupt old habits in order to allow new ones to be adopted); provide intrinsic motivation (e.g., satisfaction or happiness from the behavior); change how people think about the behavior (e.g., that the behavior is more important or desirable); change the perception of future costs (make the new behavior easier and less costly than changing back)
Tiefenbeck et al., 2013	other empirical	no	both	feedback	While water consumption feedback flyers successfully reduced water consumption (by 6%), electricity consumption increased by 5.6% compared with the control group.
Tiefenbeck et al., 2018	RCT	yes	water	feedback	Uninformed hotel guests exposed to real-time feedback using smart shower meters consumed significantly less (11.4%) energy per shower than the control group.
Toft et al., 2014	RCT	yes	electricity	framing	The paper finds that an opt-out framing is more effective in promoting AMI participation than an opt-in framing. When participants are forced to make an active choice between opting in or opting out, the same level of participation rates as in the opt-out condition is found.
Visser et al., 2021	RCT	yes	water	feedback; incentives-symbolic	The study uses a randomized control trial to investigate the impact of two behavioral interventions on water usage: detailed water usage data feedback from smart meters and an inter school competition. Interventions reduced water usage in these schools by 15–26%.
Warkentin et al., 2017	other empirical	yes	electricity	N/A	The data collected by smart meters raises questions of privacy and ownership. The primary concern is that the data may not be adequately protected and that others (e.g., hackers, businesses, and intelligence organizations) might be able to obtain it to gather information about consumers' lifestyles and behaviors. One of the most sensitive issues related to smart meter adoption involves the right to exploit consumers' usage data for commercial purposes. To address the concerns of consumers, utility companies will need to work with regulators to define how energy data can and cannot be used. Parallels can be drawn with the experience of the

					telecommunications industry in allowing the usage of phone data, which is also sensitive and reveals information about personal habits and lifestyle choices.

Table A2: Literature summary on savings associated with AMI				
Name	**Type**	**Water /Electricity**	**Savings estimate (%)**	**Description/Findings**
Liu and Mukheibir, 2018	meta-analysis/ sys-review	water	3 - 10	Real-time feedback results in marginally higher water savings compared to less frequent feedback. Long-term interventions were more effective than short ones. The review did not find any evidence for the impact of baseline water consumption on the effectiveness of water consumption programs. For the best impact, the interventions should combine push and pull notifications, leaks notification system, real time consumption feedback
Torriti, 2020	meta-analysis/ sys-review	electricity	4	The meta-analysis presented as part of the book concludes that with time, the quality and sample sizes used in trials with smart meters increased. On the contrary, the saving effect estimates decreased, meaning that smart meters are progressively losing ground as a tool to reduce consumption. The key benefit of smart meters is that they make consumption more tangible and can spark interaction and behavior change based on the information they provide.
Battala-Bejerano et al., 2020	meta-analysis/ sys-review	electricity	2 to 32	The estimate is for providing feedback on electricity consumption. The large heterogeneity effects are moderated by household income, energy characteristics of the home, family size, environmental attitudes, and ownership of central air conditioning (households with central air con are more price-responsive and produce higher absolute percentage reductions in consumption).
Bertoldi, 2016	meta-analysis/ sys-review	electricity	5-10	Achieving 5-10% of energy savings is realistic when the provided feedback is highly personalized, presented clearly, involving water saving advice, delivered regularly with high frequency, associated with target goal and social proof.
Daminato et al., 2021	other empirical	water	2	A quasi-experiment involving 31,000 households in Canary Islands found that simply replacing the meters for smart meters and by providing households the means to access the web portal and hourly consumption monitoring resulted in 2% water conservation.

Nilsson et al., 2018a	other empirical	both	5-15	Saving money and protecting the environment were two main motives mentioned by 12 households participating in a smart meter trial and a subsequent in-depth interview. Compared to electricity consumption in kWh, water consumption in L was easily understandable to users. Smaller households compared to families were able to conserve more. Users engaged with smart displays a lot in the first weeks/months but then their interest dropped.
Erickson et al., 2012	other empirical	water	6.6	Conducted a 16-week trial with 303 volunteer households who were provided with an access to a portal. Out of the surveyed households, 45% reported a change in their water consumption behavior as a result of using the portal and 39% made a change to their existing water infrastructure (most frequently fixing the leaks). Overall, 61% of portal users reported to make changes to their water use patterns or water appliances during the pilot.
Gans et al., 2013	other empirical	electricity	10-13	The study estimated the impact of installing in-home-displays to households that provided access to real-time electricity consumption data. Savings in the households supplied with the displays were in the range of 10 to 13%.
Beal and Flynn, 2015	other empirical	water	10	Based on interviews with a senior manager of Water Corporation of Western Australia and a counselor of Mackay Regional Council, smart meter roll-out led to approximately 10% reduction in water consumption and peak water consumption, respectively.
Harding and Hsiaw, 2014	other empirical	electricity	4-11	When consumers set energy savings goal that were realistic, they were able to save much more energy (11%) compared to the average of the sample (4%)
Liu et al., 2017	RCT	water	4.2	The intervention group saved an overall average of 24.1 liters per household per day (L/hh/d) (4.2%). Using the portal was a key predictor of water savings. Leak alerts functionality was popular with portal users - when offered through the portal, 78% signed up for the leak alerts (via SMS or emails). Another popular function was alerting users when 80% of their self-determined water budget was consumed. Portal uptake was 30% among the customers assigned to the experimental group.
OFGEM, 2011	RCT	electricity	3	Multiple trials by UK utilities found that smart meter roll-out led to highest energy savings among high-consumption households, households with fewer members. One trial found that households in fuel poverty showed more engagement with the intervention, possibly because they were more motivated to save money.

Tiefenbeck et al., 2016	RCT	water	22	The trial installed shower meters to single and couple households. The meter provided direct feedback on liters consumed when showering. Households with high baseline consumption saved more water compared to low-consumption baseline. Similarly, pro-environmental attitudes led to larger reductions in water consumption.
Ivanov et al., 2013	RCT	electricity	15	The study installed an in-home-display in 125 households. The display showed a "red alert" signal on days when electricity demand and cost was high, helping users to defer usage of their dishwashers and other appliances to reduce their peak energy consumption. It also automatically increased their thermostat level by 3° F.
Schleich et al., 2017	RCT	electricity	5	Providing feedback to 1525 - either via web portals or post - reduced energy consumption by 5%. The effect persisted over 11 months.
Nilsson et al., 2018b	RCT	electricity	0-16	The intervention rolled out in-home-displays to 154 households and offered two types of incentives - financial (reduced electricity cost in off-peak period) and environmental (saved money was used to purchase carbon offsets). Financial incentives were more effective than environmental ones. Largest reductions were achieved in single or couple households compared to families. Rental households achieved larger reductions compared to tenant-owned households.
Geelen et al., 2019	RCT	electricity	0	The trial provided users with an app that tracked their energy consumption in real time. This feedback itself did not produce any significant savings. It is important to provide actionable steps together with the feedback.
Erickson et al., 2013	other empirical	electricity	3.7	A 20-week pilot that tested an electricity consumption portal with 765 volunteers. It enabled them to set goals, provided incentives and showed social comparisons. In response, the households reduced their electricity consumption by 3.7% on average. They reported both changes in behavior and upgrading the electricity infrastructure.
Schleich et al., 2011	RCT	electricity	3.7	Feedback on electricity consumption together with information about electricity saving measures provided under the smart metering programme results in electricity savings of around 3.7%.

8.2 Utility survey

8.2.1 Notes on data cleaning

Upon receiving the raw dataset from AWWA, we conducted data cleaning using the statistical software Stata before analyzing the data. We undertook the following steps to remove duplicated and invalid responses:

a. There are a total of 49 duplicated responses (i.e., multiple people from the same utility were surveyed) from 22 utilities. We used the following criteria to keep only 1 observation per utility:

    i. First, we dropped duplicates that are incomplete (n = 10) and were left with 33 duplicated responses from 16 utilities.

    ii. Second, we dropped responses filled out by non-executives or non-management (n = 11) and were left with 12 duplicated responses from 6 utilities.

    iii. Finally, for the remaining 6 pairs of duplicated responses:

        1. We first kept the response that was filled by people whose roles/positions at the utility are more senior (n = 3);

        2. Then we kept the response that included contact details (n = 1);

        3. And for those that don't seemingly have any significant differences, we kept the response that was filled out first (n = 2).

b. We dropped all nonsensical responses (e.g., utility that is named "sss").

c. We also dropped incomplete responses.

Once data cleaning is complete, we have a sample size of 322 utility representatives from 44 states across the US.

8.2.2 Supplementary figures

Figure A1. Consumer segments

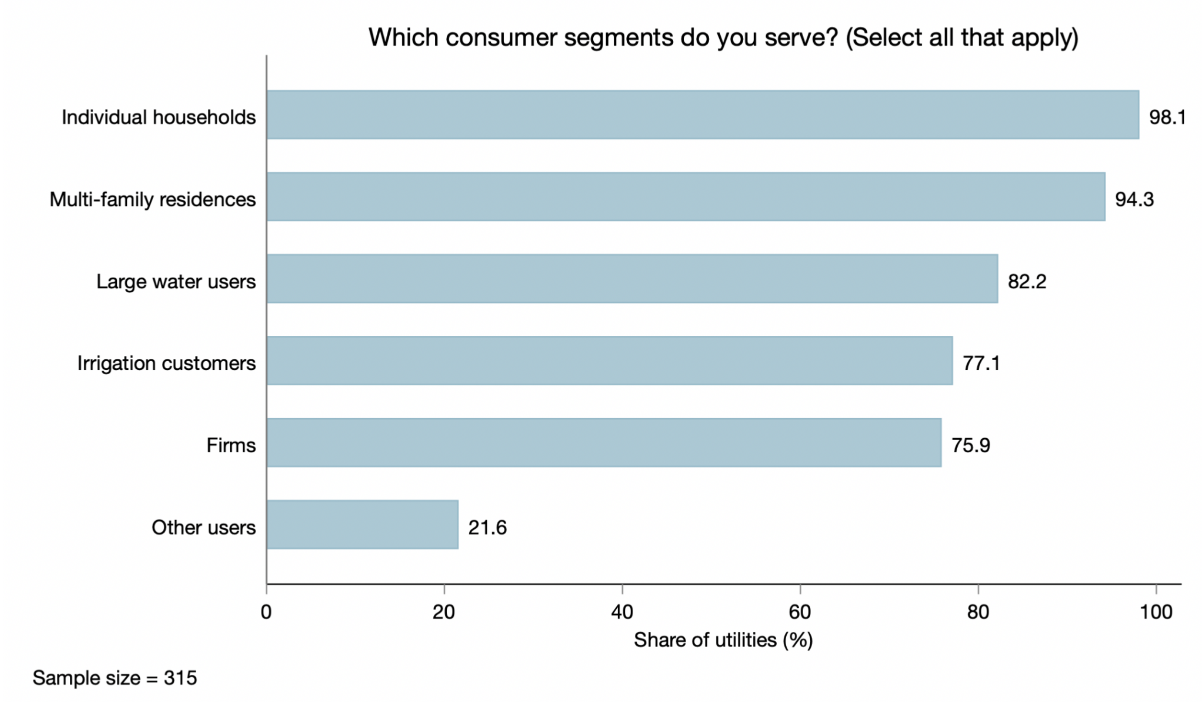


Figure A2. Number of connections

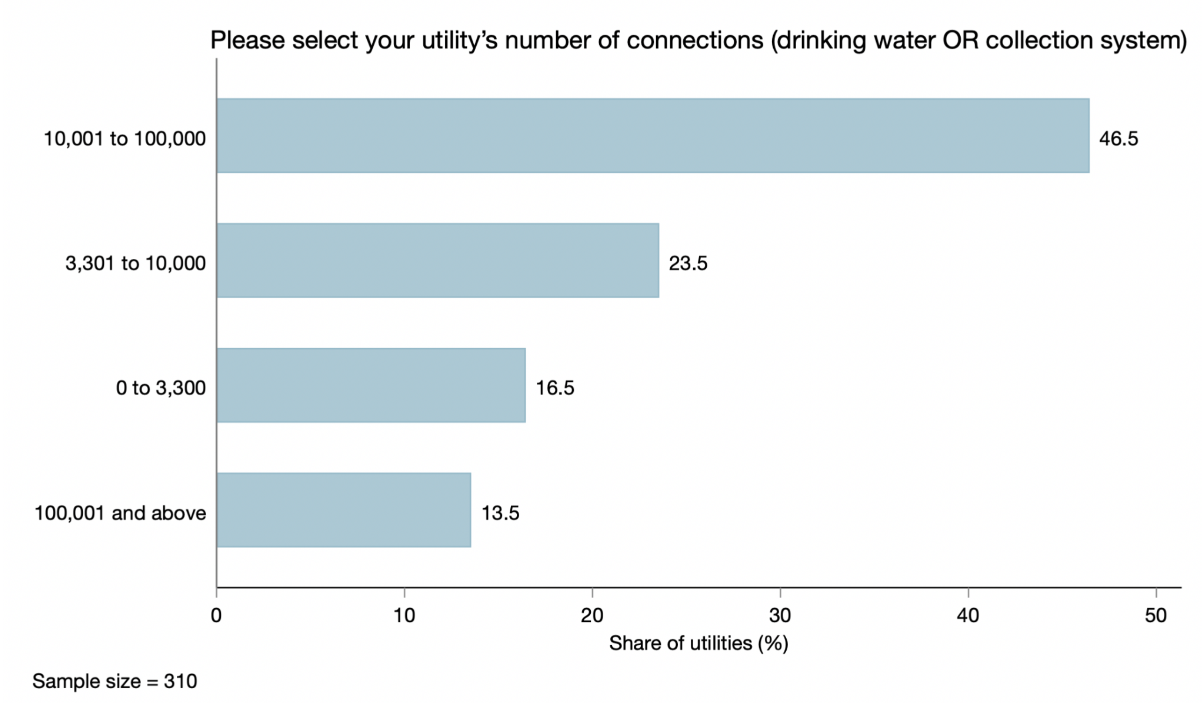
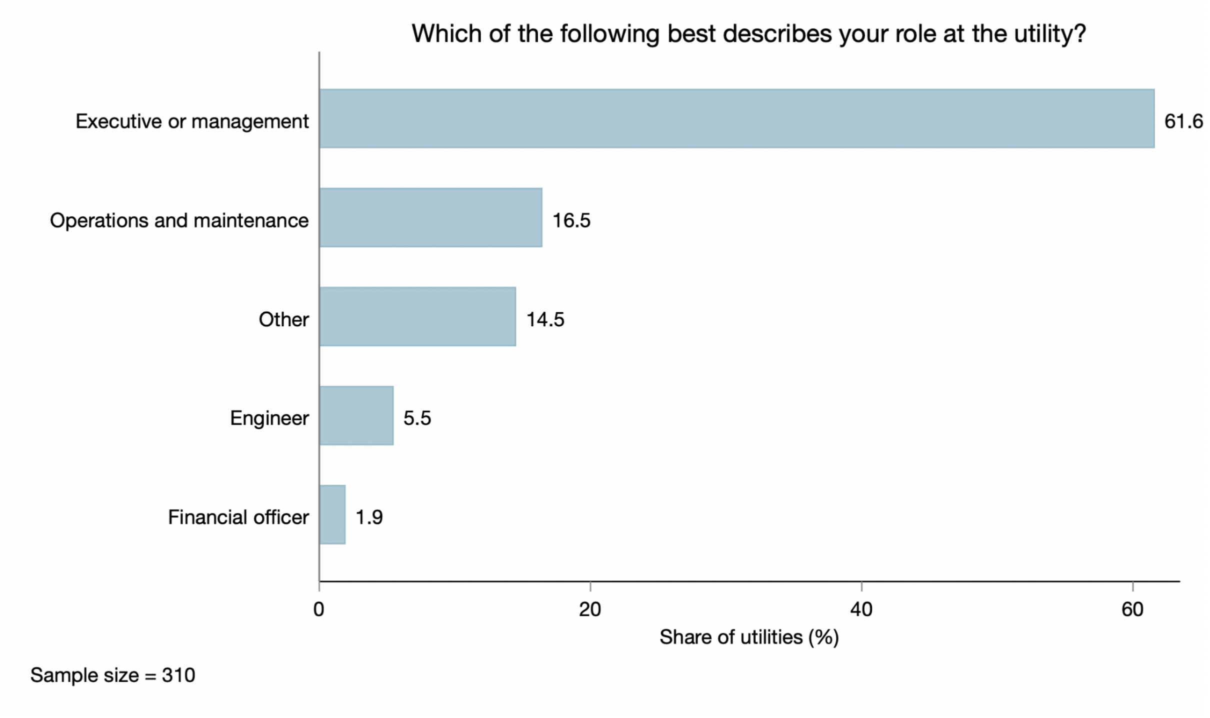


Figure A3. Respondents' role at utility



8.3 Communication designs for portal sign-up trial

8.3.1 Design sample - Main intervention (vanilla)

[redacted]

WaterSmart is now live!

Your Online Engagement & Water Insight Tool

Hello Courtney,

Mount Pleasant Waterworks is delighted to offer you exclusive access to our FREE water use customer portal.

You will be able to track your water consumption, set threshold and leak alerts, view and pay your bills online, as well as gain access to other useful features.

What's in it for you?

- **Track and understand your water use with our detailed analysis**
- **Avoid billing surprises by setting usage alerts that best suit your needs**
- **Receive updates and notifications promptly via your preferred channel**
- **Get interactive money and water-saving recommendations customized for you**
- **Achieve smarter water use and lower monthly bills**

To start enjoying these benefits, all you have to do is register using your zip code and account number [redacted]

CLICK HERE TO SIGN UP FOR THE PORTAL

You can find more information about the portal online. You may also email us or call customer service at (843) 884-9626 for assistance.

Be a smart water user and sign up today!

Thanks for caring about your water use,
Mount Pleasant Waterworks

8.3.2 Design sample - Main intervention (dynamic norm)

[redacted]

WaterSmart is now live!

Your Online Engagement & Water Insight Tool

Hello Seana,

Mount Pleasant Waterworks is delighted to offer you exclusive access to our FREE water use customer portal.

You will be able to track your water consumption, set threshold and leak alerts, view and pay your bills online, as well as gain access to other useful features.

What's in it for you?

- **Track and understand your water use with our detailed analysis**
- **Avoid billing surprises by setting usage alerts that best suit your needs**
- **Receive updates and notifications promptly via your preferred channel**
- **Get interactive money and water-saving recommendations customized for you**
- **Achieve smarter water use and lower monthly bills**

To start enjoying these benefits, all you have to do is register using your zip code and account number [redacted]

Become an early adopter by joining thousands of people who are signing up for the portal!

CLICK HERE TO SIGN UP FOR THE PORTAL

You can find more information about the portal online. You may also email us or call customer service at (843) 884-9626 for assistance.

Be a smart water user and sign up today!

8.3.3 Design sample - Main intervention (loss framing)

[redacted]

WaterSmart is now live!

Your Online Engagement & Water Insight Tool

Hello Nicholas,

Mount Pleasant Waterworks is delighted to offer you exclusive access to our **FREE** water use customer portal.

You will be able to track your water consumption, set threshold and leak alerts, view and pay your bills online, as well as gain access to other useful features.

As you are not currently registered, here's what you are missing out on:

- **Track and understand your water use with our detailed analysis**
- **Avoid billing surprises by setting usage alerts that best suit your needs**
- **Receive updates and notifications promptly via your preferred channel**
- **Get interactive money and water-saving recommendations customized for you**
- **Achieve smarter water use and lower monthly bills**

To start enjoying these benefits, all you have to do is register using your zip code and account number [redacted]

CLICK HERE TO SIGN UP FOR THE PORTAL

You can find more information about the portal online. You may also email us or call customer service at (843) 884-9626 for assistance.

Be a smart water user and sign up today!

Thanks for caring about your water use,
Mount Pleasant Waterworks

8.3.4 Design sample - Main intervention (incentive)

UTILITY DEPARTMENT

Dear Joanne,

The City of Bend Utility is delighted to offer you exclusive access to our water use customer portal. The portal is FREE to use and is currently available only to our Advanced Metering Infrastructure (AMI) water customers.

You will be able to track your water consumption, set threshold and leak alerts, request water saving kits, as well as gain access to other useful features.

What's in it for you?

- Understand your water use with our detailed analysis and monthly water reports

- Avoid billing surprises by setting usage alerts that best suit your needs

- Receive updates and notifications promptly via your preferred channel

- Get interactive money- and water-saving recommendations customized for you

- Achieve smarter water use and lower monthly bills

To start enjoying these benefits, all you have to do is register using your zip code and account number (follow link below).

WaterSmart Program

For a limited time only, you will be entered into a lottery to win a $100 bill credit on your next water bill if you register for the portal before 9/28/2021!

You can find more information about the portal online. You may also email us at bendwatersmart@bendoregon.gov for assistance.

Be a smart water user and sign up today!

Sincerely,
Dan Denning
City of Bend

This email was sent to [redacted] from City of Bend and refers to account [redacted]

8.3.5 Design sample - Reminder (vanilla)

[redacted]

WaterSmart is now live!

Your Online Engagement & Water Insight Tool

Hello Courtney,

This is a reminder from Mount Pleasant Waterworks to register for our FREE water use customer portal.

You will be able to track your water consumption, set threshold and leak alerts, view and pay your bills online, as well as gain access to other useful features.

What's in it for you?

- **Track and understand your water use with our detailed analysis**
- **Avoid billing surprises by setting usage alerts that best suit your needs**
- **Receive updates and notifications promptly via your preferred channel**
- **Get interactive money and water-saving recommendations customized for you**
- **Achieve smarter water use and lower monthly bills**

To start enjoying these benefits, all you have to do is register using your zip code and account number [redacted]

CLICK HERE TO SIGN UP FOR THE PORTAL

You can find more information about the portal online. You may also email us or call customer service at (843) 884-9626 for assistance.

Be a smart water user and sign up today!

Thanks for caring about your water use,
Mount Pleasant Waterworks

8.3.6 Design sample - Reminder (active choice)

UTILITY DEPARTMENT

[redacted]

Dear Warren,

This is a reminder from The City of Bend Utility to register for our water use customer portal. The portal is FREE to use and is currently available only to our Advanced Metering Infrastructure (AMI) customers.

You will be able to track your water consumption, set threshold and leak alerts, request water saving kits, as well as gain access to other useful features.

What's in it for you?

- Understand your water use with our detailed analysis and monthly water reports
- Avoid billing surprises by setting usage alerts that best suit your needs
- Receive updates and notifications promptly via your preferred channel
- Get interactive money- and water-saving recommendations customized for you
- Achieve smarter water use and lower monthly bills

To start enjoying these benefits, all you have to do is register using your zip code and account number (Follow the link here:WaterSmart Program).

If you do not wish to sign up, could you please let us know why by completing the survey below

Complete-1 min survey

You can find more information about the portal online. You may also email us at bendwatersmart@bendoregon.gov

Thanks for caring about your water use,

Dan Denning

City of Bend

This email was sent to [redacted] from City of Bend and refers to account [redacted]

8.4 Communication designs for newsletter sign-up trial

8.4.1 Design sample - Main intervention (Control)

Hello Sean,

Arizona is currently experiencing a drought, and Colorado River supplies are decreasing.

Based on the current hydrology, it is likely that the US Bureau of Reclamation will announce a Tier 1 shortage level for 2022. A shortage will result in a substantial cut to Arizona's share of the Colorado River. This would primarily affect agricultural users, and **NOT** affect municipal water providers such as Global Water Resources.

Arizona is doing what it can by investing in water infrastructure, supplies, and conservation. Though Global Water Resources will **not** be directly impacted, we are prepared for drought. We understand that water is precious, so we implement maximum planning and conservation practices to ensure the most efficient use of water.

You can help by continuing to conserve and use water wisely.

Thank you,

Shaina Shay
Water Resources and Conservation Specialist

8.4.2 Design sample - Main intervention (Vanilla)

Hello Wendy,

Arizona is currently experiencing a drought, and Colorado River supplies are decreasing.

Based on the current hydrology, it is likely that the US Bureau of Reclamation will announce a Tier 1 shortage level for 2022. A shortage will result in a substantial cut to Arizona's share of the Colorado River. This would primarily affect agricultural users, and **NOT** affect municipal water providers such as Global Water Resources.

Arizona is doing what it can by investing in water infrastructure, supplies, and conservation. **But we would like your help to make sure that the situation does not get worse in the future.**

You can play your part by signing up to our new conservation e-newsletter, which will provide you with advice about how to conserve and continue to use water wisely.

CLICK HERE TO SIGN UP FOR THE CONSERVATION E-NEWSLETTER

Thank you,

Shaina Shay
Water Resources and Conservation Specialist

8.4.3 Design sample - Main intervention (Commitment)

Hello Devere,

Arizona is currently experiencing a drought, and Colorado River supplies are decreasing.

Based on the current hydrology, it is likely that the US Bureau of Reclamation will announce a Tier 1 shortage level for 2022. A shortage will result in a substantial cut to Arizona's share of the Colorado River. This would primarily affect agricultural users, and **NOT** affect municipal water providers such as Global Water Resources.

Arizona is doing what it can by investing in water infrastructure, supplies, and conservation. **But we would like your help to make sure that the situation does not get worse in the future.**

Are you willing to commit to conserving water this summer? You can play your part by signing up to our new conservation e-newsletter, which will provide you with advice about how to conserve and continue to use water wisely.

CLICK HERE TO SIGN UP FOR THE CONSERVATION E-NEWSLETTER

Thank you,
Shaina Shay
Water Resources and Conservation Specialist

8.4.4 Design sample - Main intervention (Exclusivity)

Hello Maria,

Arizona is currently experiencing a drought, and Colorado River supplies are decreasing.

Based on the current hydrology, it is likely that the US Bureau of Reclamation will announce a Tier 1 shortage level for 2022. A shortage will result in a substantial cut to Arizona's share of the Colorado River. This would primarily affect agricultural users, and **NOT** affect municipal water providers such as Global Water Resources.

Arizona is doing what it can by investing in water infrastructure, supplies, and conservation. **But we would like your help to make sure that the situation does not get worse in the future.**

You can play your part by signing up to our new conservation pilot program. **There are limited spaces available.** Everyone who signs up will receive an e-newsletter, which will provide you with advice about how to conserve and continue to use water wisely.

CLICK HERE TO SIGN UP FOR THE CONSERVATION E-NEWSLETTER

Thank you,

Shaina Shay
Water Resources and Conservation Specialist

8.4.5 Design sample - Reminder (Control)

Hello Edward,

On Monday August 16th, the U.S. Secretary of the Interior declared the first-ever Tier 1 shortage on the Colorado River due to record low water levels in Lake Mead.

The Tier 1 shortage will go into effect in 2022 and will result in a substantial cut to Arizona's share of the Colorado River. This cut will primarily affect agricultural users, and **NOT** affect municipal water providers such as Global Water Resources.

Arizona and water utilities like Global Water Resources have long prepared for this announcement by diversifying water supplies, investing in infrastructure, and committing to conservation.

While Arizona has enough water to thrive, we don't have enough water to waste. **You can help to make sure that the situation does not get worse in the future by continuing to conserve water.**

Thank you,

Shaina Shay
Water Resources and Conservation Specialist

8.4.6 Design sample - Reminder (Vanilla)

Hello Ashley,

On Monday August 16th, the U.S. Secretary of the Interior declared the first-ever Tier 1 shortage on the Colorado River due to record low water levels in Lake Mead.

The Tier 1 shortage will go into effect in 2022 and will result in a substantial cut to Arizona's share of the Colorado River. This cut will primarily affect agricultural users, and **NOT** affect municipal water providers such as Global Water Resources.

Arizona and water utilities like Global Water Resources have long prepared for this announcement by diversifying water supplies, investing in infrastructure, and committing to conservation.

While Arizona has enough water to thrive, we don't have enough water to waste. **You can help to make sure that the situation does not get worse in the future.**

You can do your part by signing up to our new conservation e-newsletter, which will provide you with advice about how to conserve and continue to use water wisely.

CLICK HERE TO SIGN UP FOR THE CONSERVATION E-NEWSLETTER

Thank you,

Shaina Shay
Water Resources and Conservation Specialist

8.4.7 Design sample - Reminder (Commitment)

Hello Melissa,

On Monday August 16th, the U.S. Secretary of the Interior declared the first-ever Tier 1 shortage on the Colorado River due to record low water levels in Lake Mead.

The Tier 1 shortage will go into effect in 2022 and will result in a substantial cut to Arizona's share of the Colorado River. This cut will primarily affect agricultural users, and **NOT** affect municipal water providers such as Global Water Resources.

Arizona and water utilities like Global Water Resources have long prepared for this announcement by diversifying water supplies, investing in infrastructure, and committing to conservation.

While Arizona has enough water to thrive, we don't have enough water to waste. **You can help to make sure that the situation does not get worse in the future.**

Are you willing to commit to conserving water this summer? You can do your part by signing up to our new conservation e-newsletter, which will provide you with advice about how to conserve and continue to use water wisely.

CLICK HERE TO SIGN UP FOR THE CONSERVATION E-NEWSLETTER

Thank you,

Shaina Shay
Water Resources and Conservation Specialist

8.4.8 Design sample - Reminder (Exclusivity)

Hello Jessica,

On Monday August 16th, the U.S. Secretary of the Interior declared the first-ever Tier 1 shortage on the Colorado River due to record low water levels in Lake Mead.

The Tier 1 shortage will go into effect in 2022 and will result in a substantial cut to Arizona's share of the Colorado River. This cut will primarily affect agricultural users, and **NOT** affect municipal water providers such as Global Water Resources.

Arizona and water utilities like Global Water Resources have long prepared for this announcement by diversifying water supplies, investing in infrastructure, and committing to conservation.

While Arizona has enough water to thrive, we don't have enough water to waste. **You can help to make sure that the situation does not get worse in the future.**

You can do your part by signing up to our new conservation pilot program. **There are limited spaces available.** Everyone who signs up will receive an e-newsletter, which will provide you with advice about how to conserve and continue to use water wisely.

CLICK HERE TO SIGN UP FOR THE CONSERVATION E-NEWSLETTER

Thank you,

Shaina Shay
Water Resources and Conservation Specialist

8.5 Newsletter designs

You're smart, how about your irrigation timer?

Smart irrigation controllers can help you automate your watering.

Learn more here.

The Colorado River Shortage

On August 16th, 2021 a Tier 1 shortage was declared on the Colorado River. While this shortage will not impact Global Water Resources customers, it is more important than ever to be water wise. Visit www.gwresources.com/ to learn more.

Don't **fall** into a pattern of **watering** all winter!

When temperatures **drop**, it's time to **update** your irrigation schedule.

Visit www.gwresources.com/conservation-education for more conservation information