Report: Public attitudes towards smart water meters

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Summary of Findings

- Overall, this research has demonstrated an **encouraging level of public receptivity** towards smart water metering when people are aware of its benefits.

- **Unmetered residents were found to be less aware** of the water scarcity challenge than metered residents. Unmetered residents generally **felt more disconnected** from both their own water usage and water bill and had a limited relationship with water, in contrast to their more hands-on experiences with other utilities and services such as energy.

21% of unmetered residents surveyed reported that they were aware that we need to be saving water, but were not thinking about it day-to-day.

- **Unmetered residents were less focused on saving water** than metered residents. Perhaps not surprising given that they pay for water at a flat rate based on property size and neither have any financial penalty for failing to take action nor have any individual benefit to gain from taking action. Our current finding about the unmetered's willingness to act to save water is in line with findings from CCW's (2021c) recent study which showed unmetered customers are less likely to say they would fit water saving devices (22%) compared to metered customers (83%).

90% of residents surveyed had smart technology in their homes.

- **Smart technology** was found to be increasingly viewed as **'the new normal'** across the age ranges surveyed. Residents valued the convenience, control and readily available insights and information they can source from smart devices.

"[Smart technology] does make you change your ways and become more innovative in your approach... You can have real savings and change habits."
Research participant

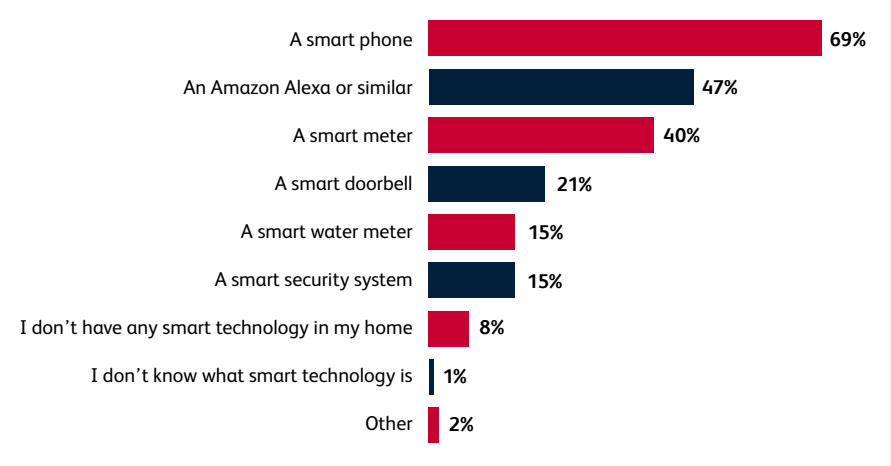

Figure 1. Responses to the research question about the kinds of 'smart' technology people currently have in their homes.

Over 87% of respondents said that they would investigate getting a smart water meter if it would lead to a reduction in their bills and be fitted at no charge.

"Your [one's] primary purpose when it comes to utilities is to save money."

"I'd love a water meter if we're going to save."

"The bills are the most important part of it..."

"They just need to offer it [the smart water meter] to me as a free thing."
Research participants

- However, 8 of the 11 residents who participated in our focus groups had very **limited knowledge** of smart water meters. Although they were generally positive about the concept of smart water metering and would accept a smart meter if offered, they **would not proactively request for one** instead of waiting for one to be offered to them or for it to be required. Proactively providing households with information and uptake as a suggested line of action can help to address this knowledge barrier and can be beneficial for a mandatory rollout programme. If successful, increased public awareness could lead to people 'buying-in' to the objective of taking up a smart water meter to save water or at the very least, gain individual benefits.

- **Upon being made aware** of the capabilities of a smart water meter, either through information awareness or lived experiences, **residents notably recognised the benefits of smart water metering, including reducing bills, having accurate bills, and having better control over usage, bills, and wastage/ leakage** as they do with other utilities and services.

"For me, it [smart water metering] makes complete sense because I've already embraced this type of technology."
Research participant

"The smart water meter is good because our water bills before were high and since we've had the smart water meter... They [the water bills] have actually gone down... It has made me think about every drop of water."
Research participant

- Residents with a smart water meter were more than twice as likely to recommend it to others than not to recommend it, demonstrating that with ownership comes an increased appreciation of the benefits of the device.

- **59% of smart water meter users surveyed reported that they had either reduced or maintained their water consumption** since their device was installed.

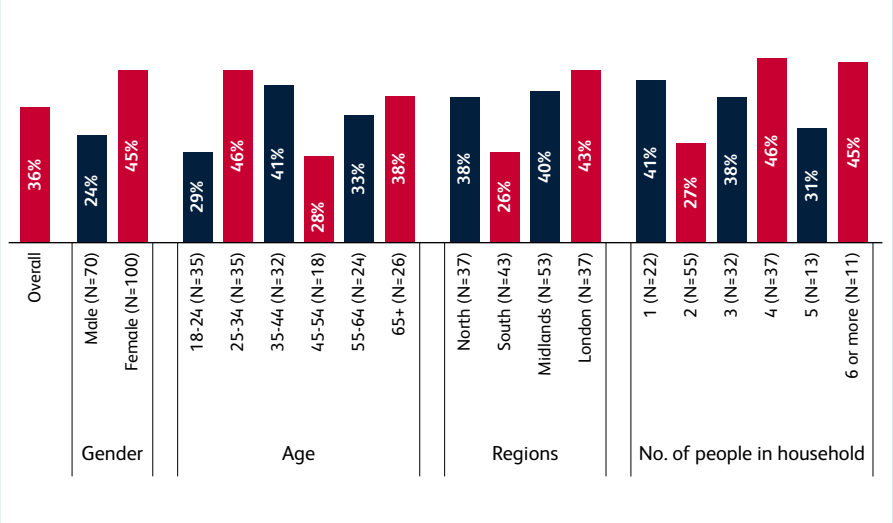

Figure 2. Agreement that having a smart water meter has been beneficial.

In a 2019 survey of 1000 people in Wales[3] respondents who had a water meter were asked whether they thought all households should be required to have a water meter. 70% said yes and only 8% disagreed. Fairness, with people paying for what they use, was identified as one of the top five benefits from smart metering in our survey.

- Research participants recognised **the environmental merits of having a smart water meter**, for example in relation to reducing their water consumption for the benefit of their local environment or to reduce carbon emissions. This category of benefits emerged as the third highest ranked benefit in our survey behind having a more accurate bill and being able to control usage/ bills. Where environmental benefits are being highlighted to customers, reciprocity and shared responsibility for water efficiency is important so organisations should be able to demonstrate what they are doing themselves to save water.

- **Fairness emerged as the fourth-highest ranked benefit of metering,** with 36% of survey participants expressing that everyone pays for water based on their actual usage. Waterwise believes that metering is the fairest way of charging for water, whilst ensuring that residents that struggle to pay are supported. This stance is in line with the Consumer Council for Water's (CCW) position that "metering is the fairest basis for water services charging", whilst representing the interests of water customers in England and Wales. This subject of fairness may become increasingly important in England and Wales as meter penetration increases with a reducing minority being charged a flat rate irrespective of usage.

- The ability of smart meters to help **detect household water leaks was also identified as an important advantage** for residents, with 35% of respondents perceiving this as a benefit to them. This recognition emerged as the fifth highest ranked benefit in our survey behind the environmental merits of smart water metering.

The main barrier to the uptake of smart water meters were the concern about rising water bills, with 37% of our respondents concerned about this possibility.

However, this barrier is generally faced by other smart metering technologies such as energy and is indeed not exclusive to smart water metering.

- The **most common barrier to uptake** identified both in this research and in the wider literature is **residents' concern that their water bill** will go up. **Nevertheless, 80% of unmetered survey respondents would still investigate getting a smart meter if they knew it would save them money and be free to install.**

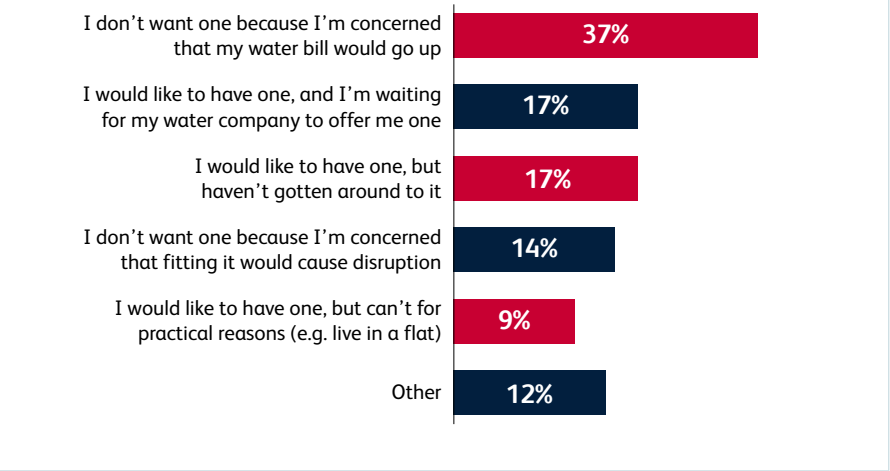

Figure 3. Reasons for not having a water meter.

So, having access to facts, figures, and tools that are specific and relevant to residents can support their decision making (such as case studies from comparable households or the use of the CCW calculator as well as the use of trial periods that enable households to test the impact of a smart meter on a shadow bill) could help to address this barrier, which in many cases will be unfounded.

- Property type was the main predictor of objection to smart water metering, with a combined 48% of participants living in households of six or more people 'somewhat likely' or 'very likely' to reject the offer of a free smart water meter.

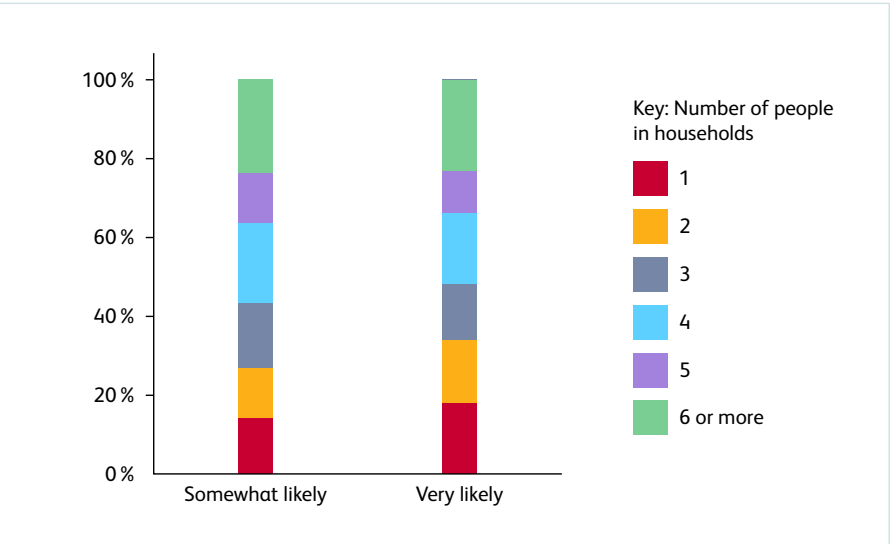

Figure 4. People likely to object to having a smart water meter based on household size.

- Some **common misconceptions about smart metering emerged from this research**, specifically around having to pay for a meter installation, potential disruption during installation, the meter consuming a lot of energy, and data protection breaches. However, these can be addressed upfront through effective marketing and communication.

- When communicating with the public about smart water metering, **segmenting audiences** according to what they might view as the biggest benefit or the strongest motivator for uptake and tailoring messages will be more effective than a generalised 'broadcast' style communication. It is also important in rolling out meters to also **engage with residents about underlying factors** such as water behaviours, normative usage practices, and other interconnected water systems that shape their water demand.

- **To increase public receptivity** to smart water meters, qualifying households will benefit from being provided with **clear information** about the cost implication and process of installing a smart water meter. Also, unqualifying households will benefit from being informed about the reason why they cannot have a water meter installed and the next line of action to be taken to achieve water efficiency. In addition, people who are typically concerned with their water bill increasing following installation can benefit from face-to-face engagement. And in addition to using incentives to motivate uptake, proxies such as landlords can be engaged and liaised with to increase smart water metering in households with occupants who do not feel responsible for their water.

Introduction

Waterwise was commissioned by Arqiva Ltd to undertake a social research project investigating public attitudes towards smart water meters.

The research project comprised three elements:

Part One A literature review of recent research on people's attitudes towards water metering including perceived benefits and barriers to uptake.

Part Two A survey of 1,026 UK residents which assessed the public's attitude towards smart water metering including perceived benefits and barriers to uptake.

Part Three Two focus groups that explored in more depth people's perceptions of and attitudes towards smart water metering.

The findings are discussed in each relevant section of the report with several overall conclusions also presented.

Part One: Literature Review

Unlike 'dumb' conventional water meters, smart water meters can electronically feed real-time and detailed water consumption information back to residents and their water utilities, a departure from the less frequent meter readings that most utilities currently take.

Studies have shown that the ability of smart water meters to collate and communicate real-time data at a disaggregated household level enhances monitoring and billing accuracy which in turn awakens residents to their water usage. There is therefore a growing case for smart water metering on the grounds of its potential to improve insight about water usage and increase household water efficiency.

Smart water metering is at the centre of deliberations on effective measures to secure the UK's future water resources and consumer acceptance is key to achieving water savings offered by smart water meters. This research therefore seeks to investigate the public's attitudes towards smart water meters.

This literature review develops the background for this research by bringing together findings from 23 reports detailing insights and analysis into people's attitudes towards water metering, with the majority of these focused specifically on smart water metering. Due to the dearth of UK-focused research on residents' attitudes towards smart water metering, this review draws from other countries that are culturally comparable to the UK, for example, Australia, the US, and some countries in Europe.

1.1 Attitudes towards smart water metering

Overall, existing research on people's receptivity to smart water metering demonstrates positivity towards the concept (see Holley and Sinclair, 2013; Liu et al., 2015; Montginoul and Vestier, 2018), and this is comparable to evidence in studies on smart energy metering (see Buchanan et al., 2016).

The positive consumer acceptance of smart water metering has been increasingly evidenced in the literature over the last decade. For example, Montginoul and Vestier (2018) found that smart water metering is positively viewed by French households despite a low adoption rate. Recently, a recent UK survey of 558 respondents, Goulas (2020) explored the attitudes and perceptions of consumers towards 'advanced' smart water meters (described as those which provide real-time and detailed water use data) and measured the exact amount of water consumption for every water usage activity. The study found that nearly half (48%) of respondents would accept an advanced smart water meter for their household. A further significant proportion (43%) of respondents said they would be hesitant but might be open to accepting advanced smart water meters in the future.

Acceptance of smart water metering has been linked to positive associations made by the public. A word association exercise conducted as part of a French study found that positive associations with 'smart metering' were mentioned more frequently than negative associations, with smart metering 'spontaneously linked to positive associations... [such as] useful, simple, improved consumption monitoring... the detection of overconsumption or leaks in real time... [reduction] of water waste, [improvement] of bill management' (Montginoul and Vestier, 2018: 194).

In addition, most participants in Goulas' (2020) study were willing to accept an advanced smart water meter if they did not have to pay for the installation costs. Individuals were also very likely to accept the device if it would help them to reduce their water and insurance bills, and believed that the data provided by the device would be reliable. The highest acceptance level was recorded amongst respondents aged 35-49, while those between ages 50-64 were hesitant but not overtly rejecting of the idea.

Similarly, a recent study conducted by Koop et al. (2021) in the Netherlands which examined the attitudes of 1,037 survey respondents towards the introduction of digital water meters revealed that 93% of respondents had no objection to their utility provider investing in digital water meters, and 78% were happy to accept a free smart water meter, citing improved leakage detection, lower costs, and environmental considerations as motivating factors. In fact, only 15% of respondents were likely to refuse the offer of a free smart meter and this was due to having reservations about the reliability of the device and having concerns about their data. Interestingly, women and highly educated respondents were found to be more positive towards the idea of smart water metering.

Furthermore, over the last decade, key studies have linked people's receptivity towards the concept of smart water metering to the perceived benefits of and attitudes towards smart technology. For example, a US study conducted by Erickson et al. (2012) which gave people access to an online portal for monitoring their water usage illustrated the potential of smart water metering to drive conversations about water consumption. Findings from this study revealed that 79% of the online portal users discussed their water usage with others in their household, 62% discussed it with those outside of their household, 39% made at least one change to their water infrastructure (most frequent was fixing a leak at 29%), and 45% reported making at least one change to their water consumption behaviour.

A more recent online omnibus survey of 1,902 adults in England and Wales by the Consumer Council for Water (CCW) (2021a) found that there was an appetite for the acceptance and use of services that include smart technology, with one in three respondents (particularly younger age groups categorised as 'future customers') thinking that smart technology will play a big role in the way they manage their water usage in the future. Specifically, respondents anticipated that smart technology would provide information on the amount of water used and how much it costs, as well as send a warning when there seems to be a leak, send alerts when demand for water is high, and provide information comparing household water use to similar households. Whilst these leakage and overconsumption notifications are perceived benefits of smart water metering identified in the CCW study and are mirrored in findings from a study conducted in Israel by Cahn et al. (2020), Cahn and co-authors warn that although 61% of participants expressed an interest in downloading an application linked to smart water metering, the low cost of water meant that participants were more keen on alerts about urgent matters and showed more interest in the technology due to environmental concerns than due to the potential financial benefits of understanding and reducing their individual water consumption.

It is noteworthy that studies have also frequently related receptivity towards the concept of smart water metering to familiarity with smart technology. For example, Goulas (2020) found a higher acceptance rate amongst study participants who already had a standard water meter, as opposed to being unmetered.

A recent omnibus survey conducted by Malet-Lambert (2020) to explore how people in Wales perceive their water use brought to the fore the role of smart water metering in enhancing water efficiency. Findings from the study showed that participants with any type of water meter installed were more likely to be taking action to reduce their water use, with 82% of them citing having a water meter as a motivating factor for reducing their water usage. In fact, participants were more likely to agree with the statement, 'I can't see the point of trying to save water' if they did not have a water meter at home (15% vs. 8%) and were more likely to agree with the statement, 'I save water even if it requires additional effort' if they had a meter (66% vs. 51%).

Similarly, Koop et al. (2021) found that participants who had their own digital energy meters were more likely to accept an offer of a free smart water meter, with a higher smart water meter reception rate recorded for smart energy meter owners (88%) compared to the 69% non-owners of a smart energy meter who were receptive to a free smart water meter. It must also be noted that most participants in the CCW research (2021a) already used technology at home (for example, an Amazon Echo or a smart energy meter) and Goulas (2020) in fact affirmed that acceptance for 'advanced' smart meters rose to 64.5% amongst participants who had at least three smart devices at home, around 13% higher than participants who only had one smart device at home.

1.2 Perceived benefits of smart water metering and motivation to act

There is a high level of consistency across the research about the benefits that people associate with smart water metering which in turn motivate them to install a water meter and potentially reduce water consumption. These benefits are categorised here into individual benefits and social benefits, and these will now be discussed in turn.

Individual benefits

Insight into, and monitoring of, household water use

Over the past decade, the impact of smart water meters' differentiating ability to feed detailed water consumption data back to residents has been brought to the fore in the literature.

In Erickson et al.'s (2012) study of the impact of household water consumption feedback in the US, it was found that 77% of people using an online portal to view their water usage agreed that it increased their understanding of their own water use, 70% agreed that it enabled them to see the effects of changes they had made, and 48% said the water portal actually helped them to conserve water. During a smart metering trial in Australia conducted by Anda et al. (2013), participants reported enjoying seeing their water use in real time, and in another Australian householder survey to gather people's feedback on their water consumption, Liu et al. (2013) reported that 84% of respondents agreed with the statement, 'I want more detail about my water use', 60% were interested in receiving cost information per water using activity, and 40% were keen to learn about volume of water use per activity. Almost three quarters wanted information on where most water was used in the home. Respondents were keen to be notified of high usage, and whether they were using below or above average.

In yet another smart metering trial conducted in Australia by Liu et al. (2015), 80-90% of respondents found the feedback information interesting and felt that it let them see more opportunities to save water in the home. More than two-thirds felt motivated by the information to save water. A total of 80% said that if they were presented with information showing that they used more water than in their last bill, they would think about possible reasons for the increase, and 60% would think about whether the increase was justified. Three-quarters felt that they would respond by trying to save more water in the next period, and half said they would proactively plan how to save more water, with a similar amount feeling inclined to talk with household members about the increase.

In the same light, Montginoul and Vestier's (2018) study to investigate the adoption of smart water metering in France found that some participants cited that they were motivated to install one to reduce water wastage. And in a study conducted in Australia, Monks et al. (2021) found that those who were positive about smart metering looked forward to being more informed about their water use, particularly to receiving more information enabling them to better manage their water consumption. It must however be noted that like warnings made by Cahn et al. (2020) during their study of participants in Israel, Anda et al. (2013) found that people's engagement with an online dashboard developed using outputs from smart metering declined over time.

Being alerted to leaks and lower costs

Being alerted to leaks, and the associated reduction of unexpected household costs, has featured as another reason that people feel smart water metering would be of benefit to them (see Koop et al., 2021; Montginoul and Vestier, 2018).

The literature on digital applications that are built on smart water metering data suggests that visualisation of overconsumption plays a key role in awakening people to their usage. For example, in Erickson et al.'s (2012) examination of the success of a digital water portal system in the US, the authors looked at the effects of a water graph depicting people's water usage and found that graphical representations played a dual role, both as powerful communications mechanisms and as effective ways of engaging people. It was in this light that one participant said, 'I know I have a leak in my house... it's a leaky faucet... I just never took the time because I never saw a graphical representation... You can really picture – I mean a gallon is a gallon of milk, and you can see fifteen of those going down your drain! That makes a heck of a difference!'

It is however key to reiterate Cahn et al.'s (2020) study in which participants were generally not interested in learning about their daily water consumption but did want to receive alerts about urgent matters such as the occurrence of a leak or abnormal consumption in their home. Interestingly, several survey respondents could provide examples of how a leak alert could have saved them time and money. In the same light, in Monk et al.'s (2021: 139) study which explicitly 'aimed to trigger memories of possible past adverse water service experiences where digital metering may have enabled the problem to be avoided or at least minimised', participants cited the reduced likelihood of having to make an insurance claim as a potential benefit to them. It is in this light that 53% of survey participants considered the lowering of costs to be a 'very important advantage' of smart water metering (Koop et al., 2021:11).

Less effort and improved bill management

According to Monk et al. (2021), another perceived individual benefit of smart water metering is the relief of no longer having to report a meter reading to the household's water provider. In Monk et al.'s (2021:143) study, participants expected digital water meters to make it easier, fairer or to provide 'an opportunity for significant process change' and the authors predicted that customer satisfaction with their water providers would increase with the provision of digital water meters. In addition, the potential to improve the bill management process was also cited by study participants as a perceived benefit of smart water metering (Montginoul and Vestier, 2018).

Other less prominent benefits

Some of the public's perceived benefits of smart water metering are more prominent in the literature, especially the cost saving and other well reported benefits such as alerting customers to leaks, leak alerts leading to the reduction of insurance claims, and reduction in water demand (Monk et al., 2019). However, Monk et al.'s (2019) literature review, which incorporated interviews with water industry experts to identify unreported benefits of smart water metering, identified lesser-known benefits, such as consumers receiving customised marketing/product offers, monitoring of vacant properties, and the potential integration of smart meters with smart appliances.

Social benefits

The literature suggests that there are wider causes such as the environment and a strong belief in fairness that 'speak' to people's feelings and motivate them to act for the benefit of the collective. This is succinctly explained by Koop et al. (2021:2) who in exploring the public's attitude towards smart water metering, suggested that 'since many households use more water than they are aware of, this strategy of confronting people with their actual water use evokes feelings of discomfort that incentivises them to save water'.

Environmental benefits

As mentioned earlier in section 1.1, Cahn et al. (2020) found that most of their research participants expressed an environmental motivation for conserving water rather than an economic one. The popularity of the environmental motivation to reduce water usage is buttressed by Koop et al.'s (2021) findings which showed that 34% of their survey respondents found environmental arguments to be a 'very important advantage' of smart water meters.

Fairness

According to Monks et al. (2021) fairness from sharing the impact of regulated water use was cited by many of their survey participants as a benefit of smart water metering. In a recent survey of 1,000 people in Wales[1] respondents who had a water meter were asked whether they thought all households should be required to have a water meter. 79% of respondents said yes while only 8% disagreed (Malet-Lambert, 2020).

As with the perceived benefits, there is a high level of consistency across the research in relation to the concerns that people have about smart water metering – described here as the barriers to uptake. These barriers to uptake are in relation to the water bill, personal data, water meter installation process and requirements, and public confidence in the technology. These barriers to uptake will now be discussed in turn.

1.3 Perceived barriers to smart water metering

Concern about higher water bills

The most common concern or barrier to water metering of any kind is the notion that water bills will go up (see CCW, 2013; CCW and Southern Water, 2016; Holley and Sinclair, 2013). As observed in the literature about attitudes towards metering in general, existing research on attitudes towards smart water metering highlights concern about a rising water bill or at least a lack of reduction in bills as the main barrier to consumer receptivity (see Monks et al., 2021). CCW's (2013) study investigating the effect of a compulsory metering programme in England found that initial attitudes to the programme depended on the anticipated financial impact it would have on bills, with larger households being particularly concerned about a potential increase.

CCW and Southern Water's (2016:3) study, also on the experiences of customers who were part of a universal metering programme, found that while most reported to have had a good experience of the process, the 'overriding concern of most customers was about the financial impact and predictability of their water bill'. The study segmented participants into three groups: 'metered', 'unmetered for practical reasons', and 'unmetered due to reluctance'. Unmetered customers who were reluctant to have a meter installed were split by the researchers into two groups: the 'Active Avoiders' and the 'Disengaged'. Active avoiders believed that they would be worse off financially and wanted evidence to prove that similar households had saved money by having a meter installed while the disengaged were typically renters and did not think water metering was their responsibility. This brings to the fore a prominent gap in customer knowledge about customer's rights to trial a water meter for a set period and this was recently demonstrated by CCW's (2021b) recent survey of 5,459 customers in England and Wales which revealed that only a minority of participants were aware that a water meter could be fitted on a trial basis.

The concern about not having reduced bills following smart metering is particularly evidenced by findings from a recent series of UK-based focus groups with water and energy professionals conducted by Michalec et al. (2019). This study revealed that lack of financial gains if customers' lifestyles cannot support 'smart' decisions is a concern about smart metering, an indication that this is a barrier to smart metering in general.

Being monitored and loss of control over private data

The idea of being constantly monitored has featured as a prohibitive factor in some studies about barriers to smart metering in general. While Montginoul and Vestier's (2018) study claimed that overall people did not see smart metering as a threat to their privacy, the literature strongly indicates that for some consumers, metering, and in particular smart water metering, is associated with loss of control over their private data (see Michalec et al., 2019; Goulas, 2020), and some people have expressed feelings of distrust in relation to being monitored (see Montginoul and Vestier, 2018). In fact, Goulas (2020) highlighted that people expressed the desire to have total control of who would be able to access their data and Koop et al. (2021) reported that 17% of people who said they would refuse a smart water meter were worried that their data would get into the hands of the wrong people. This concern about personal data is not exclusive to smart water metering as this reservation has been noted in studies on smart energy metering (see Horne et al., 2015) as well as in some studies on public perception of smart technology in general (see Georgiev and Schlögl, 2018).

Inconvenience during the installation process

For some water customers, there is an assumption that the installation process for metering, including smart water metering, will be inconvenient to them (see Michalec et al., 2019) and could involve some disruption to their lives.

Cost of installation

Some study participants have expressed concern over what they assumed would be high installation costs (Goulas, 2020) or having to pay for the meters (Monks et al., 2021). Of Koop et al.'s (2021) study participants, 68% said they would not be willing to pay for a digital water meter, 7% said they would, and 25% said they would pay for a digital water meter if the water utility made an 'interesting offer'.

Concerns about reliability

In Koop et al.'s (2021) study, 22% of participants argued for the refusal of a smart water metering primarily due to doubting the reliability of the water meter.

Other less prominent barriers

Other barriers to smart metering cited less frequently in recent studies include concerns about unemployment due to meter inspectors no longer being needed, the requirement to be connected to the internet, potential health issues caused by wireless technology, and concerns over data hacking (Montginoul and Vestier, 2018). Also, in studies of concerns about metering in general (rather than smart metering specifically), people were concerned about assumed difficulties of meter location and placement (Holley and Sinclair, 2013).

1.4 Literature recommendations

Some of the studies reviewed put forward explicit recommendations for increasing customer receptivity to metering.

Notably, CCW and Southern Water's (2016) study of customers on a universal dumb metering programme suggested that early communication, direct contact, and responsiveness to individual needs are key. The authors list five 'must haves' for customer acceptance: (1) information provision about how the installation process works and what the financial impact will be, (2) for those who want one but cannot have one, information about why a meter has not been installed and what happens next, (3) a mixture of communications including written information, helpline number and face-to-face activity, (4) face-to-face engagement particularly for the 'Active Avoiders', and (5) communication via intermediaries such as landlords for the 'Disengaged'. In addition, a previous study by CCW (2013) similarly recommended information packs, face-to-face communication, information about what the water company is doing to conserve water, a helpline, and a website.

It is also noteworthy that some studies sought to explain low public acceptance of smart water metering, inherently pointing out areas where interventions for proliferation can be impactful. For instance, Montginoul and Vestier (2018) suggested that the low adoption rate of smart water meters despite the overall positive attitude to smart metering might be due to lack of a motivating incentive, and Michalec et al.'s (2019) focus groups on customer perception of smart water metering concluded with recommendations for public engagement, which should come in form of a 'support package' with tailored advice, including for vulnerable households and should create a compelling narrative that refers to both the individual and social benefits of smart water metering.

Part Two: Survey

2.1 Sample details

The research survey (see Appendix 1) was administered in July 2021 by the market research company Savanta Comres. The survey participants comprised 1,026 UK homeowners, evenly distributed across gender, age, and location in the UK.

Most participants lived in households of between two and four people, 144 participants lived alone, and 99 participants lived in a household of five people or more. Just under two-thirds of respondents lived in a household with a water meter, with 8% of all respondents reporting that their household was on a smart water meter. The majority of respondents (93%) were responsible for paying the water bill in their household (see Figure 5).

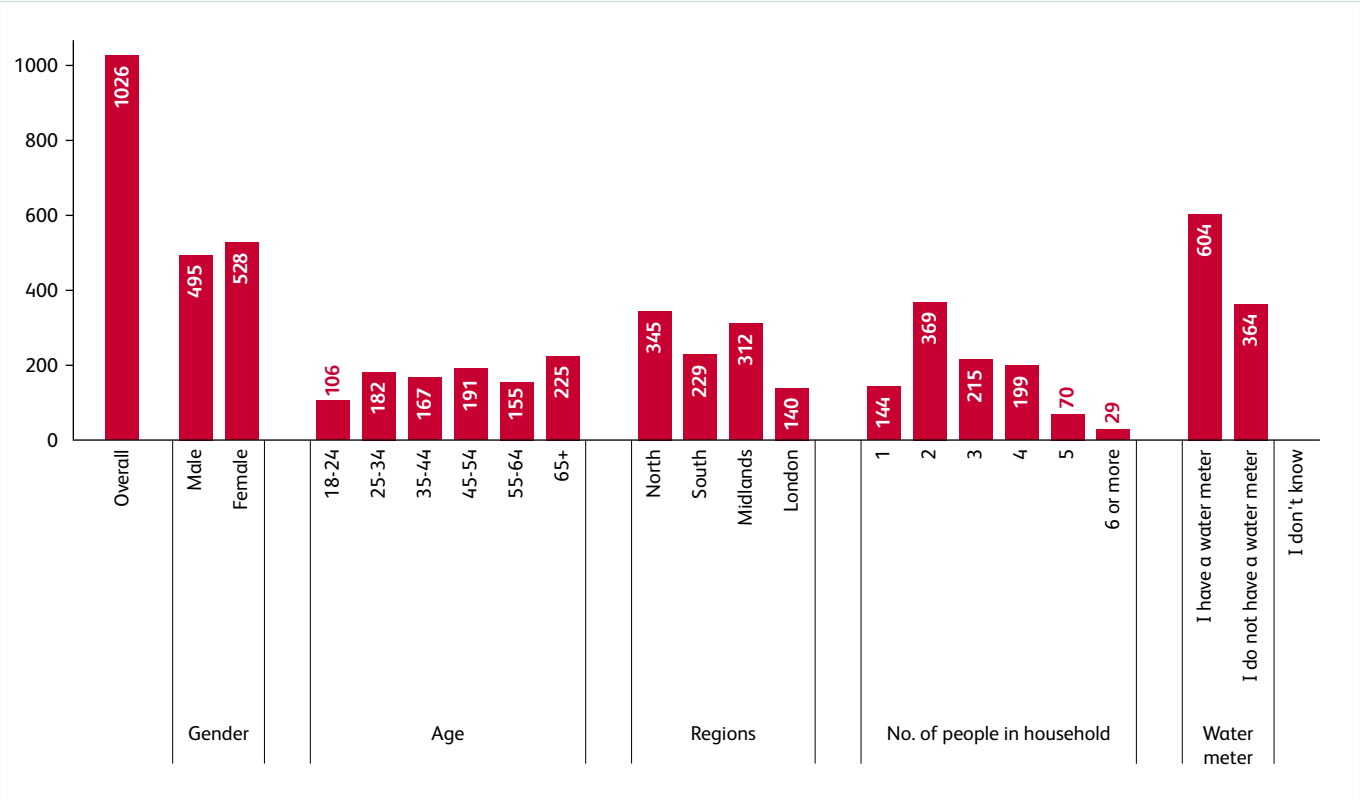

Figure 5: Sample details.

2.2 Results

2.2.1 Metering Status

A total of 59% of respondents reported that their household was on a water meter, 35% were unmetered, and 6% did not know whether their household had a meter. Fewer people in the North were metered (43%) than in the South (72%), Midlands (63%) or London (66%). Figure 2 above shows that more middle age – older adults were unmetered than younger adults and levels of metering were lower than the group average in households with 3-5 occupants.

Ownership of other smart technology

Most respondents already had some smart technology in their household. In order of decreasing magnitude, the most common device was a smartphone (69%), Amazon Alexa or similar smart 'assistant' (47%), and a smart energy meter (40%). A small minority (8%) of respondents said that they had no smart technology in their home, and 1% agreed with the statement 'I don't know what smart technology is'.

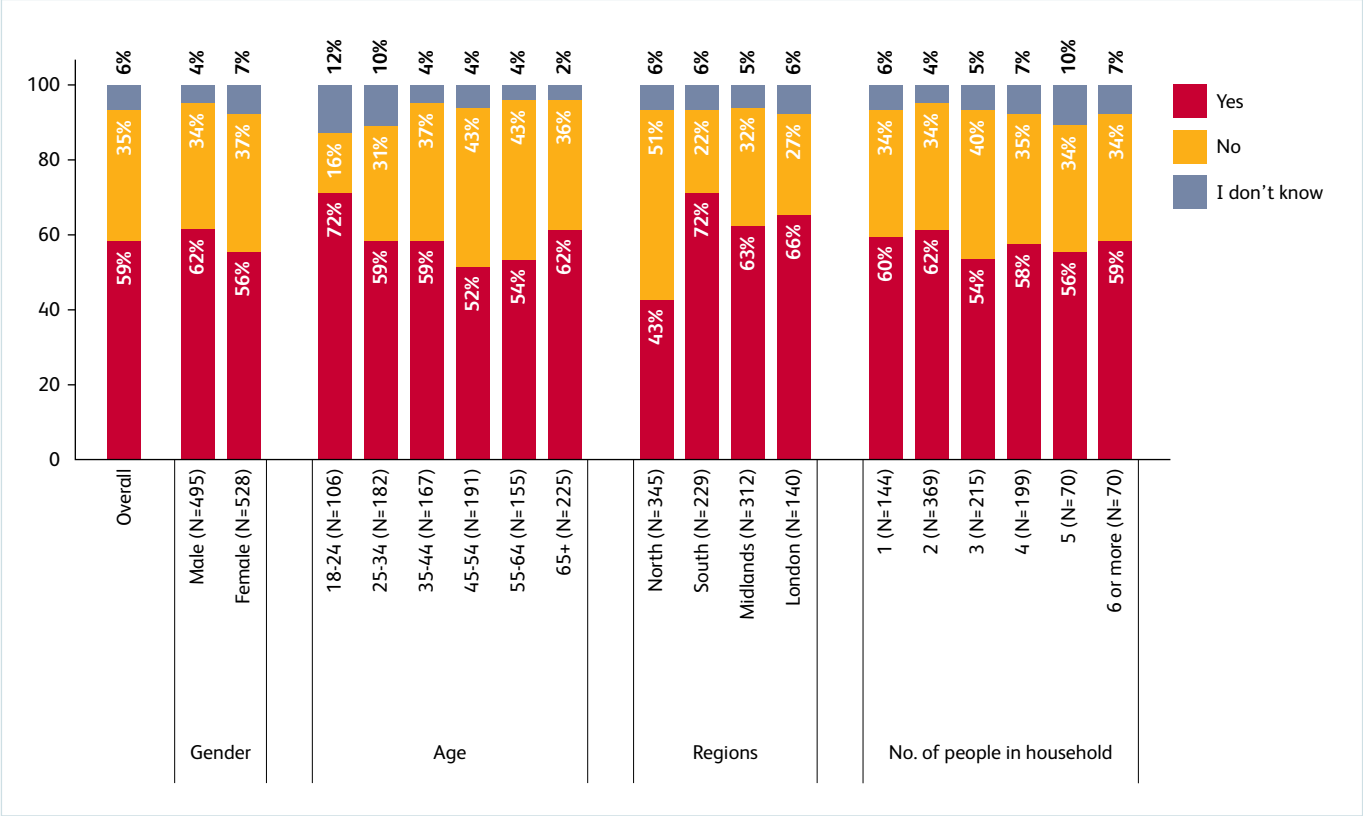

Figure 6: Metering status.

2.2.2 Awareness of water saving

The survey participants were asked whether they were 'aware of the pressure on the UK's water supply and the need to protect our water resources'. The overwhelming majority (84%) were aware of these issues, with 46% reporting that their household tries regularly to save water. A further 20% said they were aware of the need to save water but were not necessarily thinking about it on a daily basis, and 18% said that they were aware but did not know much about it. Only 13% of respondents were not aware of the issue, with a further 4% agreeing with the statement, 'I think this applies to other countries but not to the UK'. The older respondents were, the more likely they were to be regularly trying to save water at home. Being on a water meter made a difference to the likelihood that someone was making efforts to save water, with 50% of metered households, and 43% of unmetered households reporting that they were regularly trying to save water.

2.2.3 Attitudes to smart water metering: The unmetered

Respondents were provided with a brief description of a smart water meter as allowing them to track the amount of water they use and providing visibility and control over their water consumption. They were then asked, 'if your water company were able to provide you with a smart water meter for free, and you wouldn't need to do anything, how likely would you be to object to this?'

8% of respondents said that they already had a smart water meter. A further 37% said that they were unlikely to object to the offer of a smart water meter (22% very unlikely and 15% somewhat unlikely), 22% responded that they were unsure whether they would object to the offer, and 33% said they were likely to object (16% somewhat likely and 17% very likely).

Acceptance of smart water metering was evenly distributed across gender, age range (although older people were slightly less likely to object than younger), region and current metering status (both 23% of metered and unmetered were very unlikely to reject the offer of a smart water meter). People in larger households were slightly more likely to object to a smart water meter, although not as markedly as might be expected, and the most common answer given by persons living in households of five or more occupants was 'not sure'.

Respondents were then asked to select all reasons that would stop them from wanting a smart water meter. A total of 29% agreed with the statement, 'nothing would stop me from wanting one', with the highest proportion of these in the 65+ age group (46%). 36% of people on a standard 'dumb' meter and 21% of unmetered respondents also responded this way. A fair proportion of people from larger households also claimed that nothing would stop them from wanting a smart water meter, including 28% of people from 5-person households, and 18% of people from households of 6 or occupants.

2.2.4 Attitudes to smart water metering: Smart meter owners

Respondents who reported that they already had a smart water meter (8% of all survey participants) were asked to select all applicable options from a series of statements that would describe their experiences with it. While 35% of metered respondents and 29% of unmetered respondents anticipated using less water with a smart water meter, a slightly larger 37% of people already on a smart water meter said it had helped them to reduce their consumption. In addition, 36% of people with smart meters described it as having been beneficial to them, and 36% said that they would recommend a smart meter to others. While 44% of metered and 38% of unmetered respondents predicted that a smart water meter would help them to track their water consumption, slightly less people who already had a smart meter (30%) said that it did this; possibly supporting the findings from the literature review that once people have a meter installed, their tracking of their water consumption tends to drop off over time (see Anda et al., 2013).

Only 22% of people on a smart water meter claimed to have noticed no difference in the way they used water (this answer was most common among households of more than 6 people and younger respondents), 18% said their meter had not been beneficial to them (nobody over the age of 55 selected this answer), and 16% said that they would not recommend a smart meter to other people (again, most common amongst larger households and younger people).

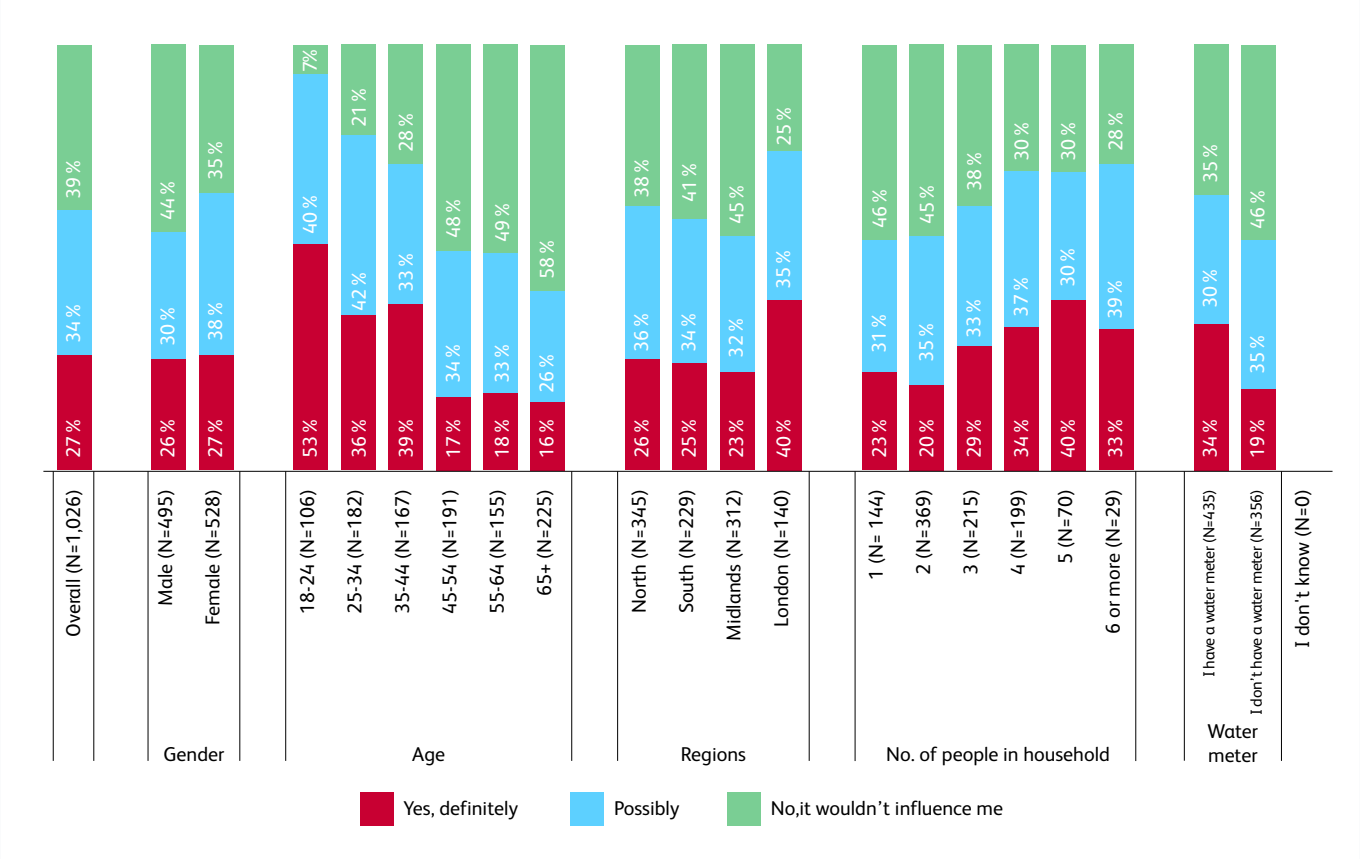

Figure 7. Responses to the research question about whether knowing someone with a smart water meter would make the respondent more likely to want one.

2.2.5 Benefits and motivations behind smart water metering

Survey participants were presented with a statement about some of the potential benefits of smart meters: the likelihood of using less water and the associated environmental benefits, reduction in greenhouse gas emissions and reduced water bills, as well as smart meters helping to detect leaks. Participants were asked to select the three biggest benefits that they felt they personally would gain from a smart water meter.

Responses about perceived benefits of smart water metering were very evenly distributed, with 43% citing greater accuracy of their water bill, 41% citing the ability to track their water usage and have more control over it, 38% citing environmental friendliness and carbon reductions, 36% saying 'it's only fair for everyone to pay for the amount of water they use' (least popular among larger households), 35% motivated by the possibility of being alerted to leaks, 32% cited that their water bill would go down because they would use less water, and another 32% were motivated by not having to pay for water when away from the home. Of respondents from larger households of six or more people, 32% felt that they would use less water and their bills would go down, 46% felt that they would have more control over their water use, 43% felt that they would be more environmentally friendly, and 54% were positive about not paying for water while away from home. Despite these positive associations with smart water metering seen across the board, overall, people already on a water meter were slightly more enthusiastic about the list of benefits presented to them than people who were unmetered.

A small minority of participants (14%) said that there were no benefits that would persuade them to get a smart water meter, with only 5-6% of participants under 34 and 21% of over 55's taking this stance. Surprisingly, this belief of being unaffected by motivating factors was evenly distributed among household sizes, with 17% of single person households, 18% of households of six or more people, and 10% of households of four people. Interestingly 9% of respondents who already had a 'dumb' meter could not identify any benefits that would persuade them to get a smart water meter, compared to 22% of unmetered respondents.

Social influences

Respondents were asked whether they felt that they would be more likely to get a smart water meter if they found out that a friend, neighbour, or family member had one. While roughly two-thirds felt that this would definitely (27%) or possibly (34%) influence their decision, 39% did not feel that this would affect them. Age appeared to be the most determining factor in this, with 93% of people under 24 feeling that they would potentially be influenced, and only 42% of the over 65's feeling that they would get a smart water meter if a friend had one.

Finally, respondents without smart water meters were asked 'if you knew that having a smart water meter installed would lead to a reduction in your bills and that it would be fitted at no charge, how likely would you be to look into getting one?'. A strong majority of 87% answered in the affirmative, with 44% very likely to investigate getting one, and 43% somewhat likely. A further 7% described themselves as somewhat unlikely, and just 6% as very unlikely.

2.2.6 Barriers to smart water metering

As with metering in general, the biggest concern for people was the possibility of their bills going up, with 37% of respondents worried about this, including nearly a third of people who already had a 'dumb' water meter (see Figure 3). This concern was widely shared across different household sizes, with around a third each of single to three-person households and five-person households worried about this, compared to half of households of six or more people.

Of the participants who were unmetered, at least half of those who lived in households of five or more people were concerned about their not having a water meter. In addition, 24% of single-person households, 38% of two-person households, 31% of three-person households and 43% of four-person households claimed to be worried about their water bills going up if on a water meter. These concern levels across all household occupancy levels demonstrate that the public perception that their water bill will rise following smart metering is not just a barrier for larger households.

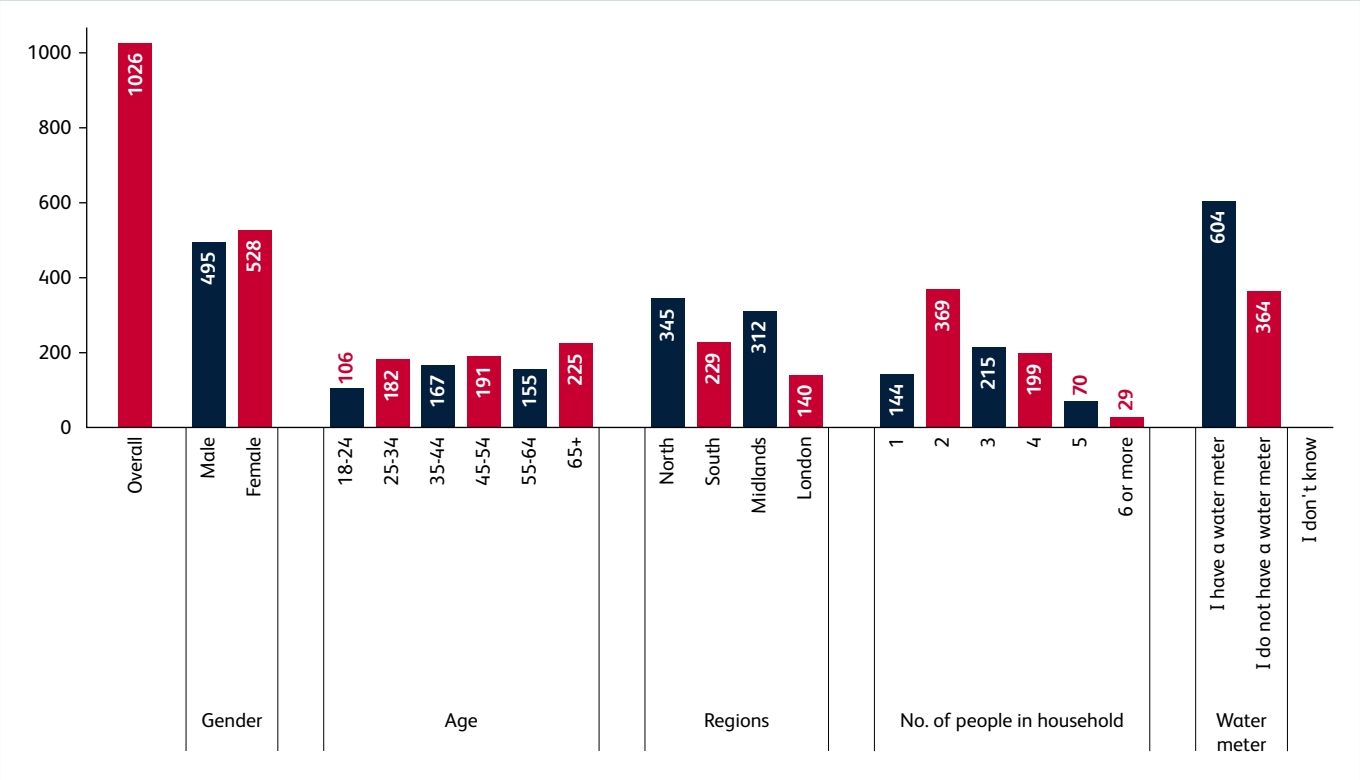

Figure 8. People concerned about their water bill going up.

The second most common reason for not having a water meter was concern about the meter installation potentially causing disruption, with 14% of respondents without a water meter citing this as a reason for remaining unmetered. About 20 respondents went further to highlight that not having a meter was the norm in Scotland or Northern Ireland where they lived.

Respondents who signified that they were not on a water meter were asked about why they remained unmetered, by selecting all reasons that applied to their circumstances. 9% reported wanting a meter but being unable to have one for practical reasons, for example, living in a flat. 17% expressed that they would like a water meter but were waiting for their water company to offer them one, and 17% said that they would like a meter but hadn't gotten around to it.

In addition, 24% of participants said that concern about the reliability or accuracy of the technology would prevent them from getting a smart water meter, in particular, 19% cited that their concern that there would be disruption during the installation process would be a barrier to uptake, 17% said that they would be concerned about their data being stored or shared, and 13% said they would be concerned that uptake would take a lot of effort on their part.

2.3 Discussion

For proponents of smart water metering, some positive insights emerged from the survey: there was an encouragingly high level of awareness amongst respondents about the need to protect resources by saving water, many people not currently on a water meter expressed the desire to have one, and people who already had smart meters were more positive about their experiences with them than negative. People not on a smart water meter saw several benefits to having one, including a more accurate bill, more control over water consumption, less water use leading to environmental and carbon reduction benefits, being alerted to leaks, and not paying for water while away from home.

The survey results showed that participants who were members of larger households (those comprising five or more people) were slightly more hesitant about smart water meters than other groups, although not to the degree that might have been predicted. Indeed, people from large households were able to identify several benefits they could gain from having a smart meter, and around a quarter claimed that nothing would stop them from wanting a smart water meter. In addition, the most popular answer to the question about whether participants would accept a smart water meter was 'not sure', demonstrating the importance of increasing engagement with larger households about smart meters, rather than assuming that they would reject an offer of one.

Although the older age group (55+) were the most likely not to have any smart technology in their homes, they were also the group most likely to be trying to save water, and least concerned with any potential disruption, the chance of their bills going up, or issues around data sharing. It is important to point out that this lack of ownership of any smart technology by people aged 50-64 means they are likely to be unfamiliar with high-tech. This unfamiliarity with smart technology further explains findings from the literature review which suggest that Baby Boomers, although open to the idea of having a smart water meter, are generally hesitant to take up one. The over 65s were the most likely to agree that it's only fair for everyone to pay for the water they use, least likely to reject the offer of a smart meter, and the most likely to say that nothing would stop them from wanting one. As a group, they were potentially very receptive to the offer of a smart water meter.

In general, however, there is a striking lack of homogeneity across demographic groups, with few trends emerging across age, gender, location in the UK and even current metering status. Thus, any engagement effort will likely not benefit from relying on the more obvious methods of customer segmentation and will need to be more tailored to individuals' different circumstances. Having said that, an awareness raising effort to increase people's understanding of smart water meters may be successful in addressing some of the incorrect assumptions, for example in relation to the installation of a smart water meter being disruptive or involving a lot of effort on the part of the householder.

In line with findings from the literature review, the survey findings affirm that the most common barrier to uptake is concerns about an accompanied rise in water bills. This concern about the implication of getting a smart water meter was expressed across demographics, including across different household sizes. While members of large households not currently on a water meter might justifiably be concerned about the potential rise in bills that could accompany a meter being installed, many respondents living in small households of one or two people also worried about their water bill going up; some perhaps unaware that in general, a household with less people than bedrooms will pay less when they switch from being unmetered to metered. It is therefore likely that concerned members of smaller households would be receptive to statistics demonstrating this. The very large majority of respondents who would be interested in getting a smart water meter if they could be guaranteed a reduction in their bills demonstrates that while other barriers such as concerns about smart technology reliability and data sharing do exist for most people, they would not be prohibitive.

Part Three: Focus Groups

For the final stage of this research, two focus groups comprising a total of 11 participants were convened to explore people's perceptions of smart water metering in more depth. Directions Research and Marketing recruited participants and facilitated the focus groups via Zoom.

Participants were informed that they were going to take part in a discussion about their utilities but were not made aware that they would be focusing on water metering. In both sessions the facilitator opened the discussion with a general exploration of attitudes towards utilities management, before progressing to focus more specifically on perceptions of smart water metering, including perceived benefits and barriers to uptake. This included being shown several statements about the potential benefits of smart water metering and commenting on how relevant these might be to them.

3.1 Group one: Unmetered participants

The first group was composed of six participants, all of whom lived in unmetered properties. Henceforth referred to as the unmetered focus group, everyone in the group was not unmetered for practical reasons, like living in a flat. All participants lived in either a detached or semi-detached house comprising two to six people. Participants in the unmetered group belonged to the mid-twenties to late sixties age range and were either solely or jointly responsible for paying their water bill.

3.1.1 Attitudes towards and management of utilities

The amount of attention that participants paid to their utilities varied, with at least half describing themselves as not monitoring their consumption (of gas, electricity, and water) particularly closely. For instance, a female living in a household of six people (including her partner, two children and parents) said that she had become much more aware, however, while staying at home during the coronavirus lockdown, so that when her electricity provider offered the household a smart electricity meter, "we went for it". She described having the meter as "a bit of a novelty...you feel a bit more knowledgeable". However, her engagement with it dropped over time, although her daughter now checks it occasionally. Another participant described a similar experience with a smart electricity meter, saying, "for me the meter doesn't really serve a purpose, it's just there". In contrast to the aforementioned experiences of people not monitoring their usage, another participant living in a household of four people had used the installation of his smart electricity meter to notice how much electricity certain appliances, like his tumble drier, seemed to be using.

In general, participants felt that they had less control over their water bill than other utilities, as they were not able to switch water suppliers. A participant in her sixties noted that she was currently in a dispute with her water provider over the rateable value of her home, as she had been put in a different (more expensive) band to the other houses on her road. Living in a household of two people, she felt that her water bill was high for the amount of water consumed, and "it would be interesting to see how much water we use... I'd love a water meter if we're going to save".

Also, there was a consensus amongst participants that they did not usually take the time to read their water bill. For example, the female living in a household of six described her water bill as "probably the one utility bill I just close my eyes and pay". Her household had three baths, three toilets, and two sets of washing machines and tumble dryers, because according to her, "there are so many people in the house". Nevertheless, she said that she would be open to getting a smart water meter, "because that would probably help [to save water]".

In addition, participants had various reasons for not having requested a standard water meter from their water company. A few simply said it was because they had never been offered one, saying, "I'd like to be offered one, with some incentive maybe, like it's going to be cheaper than I'm paying now". One person was not sure that she would be able to get a water meter for her semi-detached house, wondering whether the household attached to hers would also need to get one. Another had an outdoor tap that all his neighbours had access to and was concerned that if metered he would be paying for other people's water use. A female living with her partner and three children was concerned about her bills going up, as she felt that her family probably used more water than they were paying for.

3.1.2 Perceived benefits of smart water meters

As findings from the literature review and survey suggest, for many people, a rising water bill is the main concern when considering smart water metering especially if they suspect that they might end up paying more because of being metered. However, if people believed that they could save money on a meter, the water bill becomes a motivation to be metered. About smart water meters specifically, attitudes were generally positive, albeit in a muted way, with one participant assuming that smart water meters would be like smart electricity meters and would therefore be useful.

The high level of importance that participants attached to a reduced water bill when deciding whether to have a smart water meter is illustrated by some of their responses given when the statement 'Switching to a water meter from being unmetered could save some customers £100 or more on their water bill'. For example, one participant responded citing that:

"Your [One's] primary purpose when it comes to utilities is to save money".

When this same participant was shown the statement 'Households who have switched from being unmetered to a smart meter use on average 17% less water than they did before', he responded that he would want to be sure that he would therefore be paying 17% less on his bills than currently. It is noteworthy that other participants agreed with his view.

In addition, for some of the unmetered participants, the ability of smart water meters to help with leakage detection was a convincing benefit. Participants were shown the statement 'Smart water meters can help to detect leaks in your home. In over one year, smart meters helped one water company to detect 13,500 leaks on customer supply pipes and save nearly 18 million litres per day'. In response, one participant, a male in his thirties, stated that this was "by far the most convincing one", citing having had to call plumbers in the past to try and find whether he had a leak. Another participant agreed that this would be very beneficial, and another placed this benefit directly after the potential for saving money. Someone else pointed out that finding and fixing leaks would be another way of saving more money.

Also, the unmetered focus group recognised the ability to track water consumption as a potential merit of smart water metering. For instance, the female participant in a household of five felt that a water meter might be useful if it helped her to identify where she was using most water, speculating that, "I'd definitely stop filling up the paddling pool, anyway". However, a few participants from households with a perceived high usage and those already trying to save water had reservations about whether a water meter could lead to additional water savings. For example, one female participant stated thus:

"It is kind of difficult to avoid water usage in this home. It is what it is... I would probably get a smart meter for water because I feel like that might help but I don't know where we cut back. Not wash our clothes? I don't know! We are constantly doing laundry in this house."

In the same light, another participant, a male, reiterated the following:

"We have two young children. Myself and my wife both wear uniforms for work as well so the washing machine is basically constantly on in this house four or five times a week at least. We have two water butts installed at the front and back of the house to maximise any rainwater savings, we are constantly trying to make water savings in the house like half boiling the kettle, but I've never found the perfect storm for being efficient with water."

Whilst another participant, a male, reiterated that the way a smart water meter would help him to save water was by "highlighting where [he is] using most water" to track usage during certain times of the day, he also wondered whether it was realistic to expect to be able to save more than he did already, stating thus:

"At the end of the day it's not like we're all sitting there throwing water down the drain."

The unmetered participants' uncertainty about whether smart water metering can lead to further water savings due to personal water needs highlights one of the complexities of household water demand and the need to accompany smart water metering with customer engagement to reshape people's water usage behaviours and practices in order to maximise water efficiency. This brings to the forefront an aspect of the water demand management literature that is being shaped by practice theorists (see Watson et al., 2020) who highlight that water demand is created through normative everyday usage and advocate a socio-technical approach that addresses multiple influences of usage (for example, people, technology, and organisations) to effect change.

Furthermore, the unmetered focus group positively viewed the idea that smart water meters mean that meter readings could be taken remotely, with one participant confirming that this was "definitely a benefit" in her eyes, and others agreeing. And when the unmetered group was shown the statement that 'Smart water meters are not invasive to install and it can usually be done without entering the home', they did not find this very persuasive one way or another, as a few people argued that they did not mind engineers coming into their homes when needed anyway.

However, there was a consensus that the environmental benefits associated with using less water were not particularly persuasive to people in the unmetered focus group. Saving water for environmental reasons was not at the forefront for anyone, and any dangers related to pressure on water resources in the UK was seen as an issue that will probably only exist in the distant future.

For instance, one participant in a large household of six described the environmental benefits of potentially using less water when metered as a "positive [and] secondary" benefit, but not as important as paying less for her water. And another participant, a male in his thirties argued thus:

"It's all about the money saved, other than for the 'woke' people who care about the environment."

And another participant, a male in his sixties, succinctly put this view forward, stating thus:

"The bills are the most important part of it...what happens in the environment is sort of in the background to me."

In response to the statement 'Smart water meters can help you to reduce your carbon footprint. Installing smart water meters nationwide could help save 0.5% of the UK's greenhouse gas emissions', a male in his sixties argued that this wouldn't feel relevant to him, stating thus:

"It [Carbon footprint] doesn't affect me, and I don't tend to do anything about it."

The aforementioned feelings are reflective of many psychological distance discussions in the climate change literature (Maiella et al., 2020), particularly temporal, that highlight that despite the acknowledgement that climate change impacts are currently happening, people still perceive that the severe consequences will be felt in the distant future. In prescribing a solution to such temporal psychological distance which has been proven to be completely dictated by the level of public concern for climate change for example, the literature suggests that people will be more likely to behave in favour of the environment if they can see how the problem poses direct consequences for them (see Lorenzoni and Pidgeon, 2006; Singh et al., 2017).

3.1.3 Perceived barriers to smart water meters

Overall, participants had low levels of awareness about smart water meters, and had either not heard of them before, or had very limited knowledge of what they might do. For instance, one participant was worried that once they had a smart water meter, they would not be able to change their mind and would be "stuck with it forever". There was also some concern expressed that the householder would need to pay for the cost of a smart water meter or for its installation, although one participant argued that it would probably be free "because it would benefit the water company". And when presented with the statement 'Smart water meters can help to keep more water in the environment', one participant felt that this might indicate that there were costs associated with smart water meters, reasoning that "sustainable products often cost more". These knowledge gaps were a big barrier to even considering getting a smart water meter installed or investigating it further.

The knowledge deficit barrier to smart water metering identified amongst the unmetered focus group is portrayed in a recent study by Ajia (2020) which highlighted how the lack of information can prevent people from taking water efficient actions. In the study, Ajia (2020) used an account of water efficiency home visits to six UK households to provoke thoughts about how "unaware publics' information or knowledge deficit" ought to be addressed to enhance water efficiency, stating thus:

"...not all unmetered publics are merely unbothered... Five out of the six homes visited were unmetered and when the residents were asked why they had not opted for a water meter, it emerged that they remained unmetered due to their lack of understanding of the process for applying for a water meter [and] lack of knowledge about the benefits of the water meter..."

The chance that their water bill might go up when on a smart water meter was the next biggest barrier for every participant in the group. In response to the statement 'Switching to a water meter from being unmetered could save some customers £100 or more on their water bill', one participant living with her partner and three children argued that the potential cost savings previously mentioned might "apply to two people living in a three-bedroom house" but were unlikely to apply to her household. The female in a household of six agreed, stating thus:

"I'm definitely not 'some customers' because of the size of my house and the amount of people in it".

In addition, only one participant in the unmetered focus group, a female in her sixties, expressed concerns about "smart meters gathering your data all the time" as well as what would happen if internet connectivity failed, stating thus:

"When your internet goes down everything goes down, so would that happen [with smart water meters]?"

3.1.4 Final sentiment: motivation behind uptake

When asked at the end of the session whether anyone in the group would now seek to get a smart meter installed, one male in his thirties stated that he would accept it on the following condition:

"They just need to offer it [the smart water meter] to me as a free thing"

The female in a household of five suggested that she'd like to get one as a six-month trial, after which she would decide whether to keep it.

Also, one participant with a family of five felt that she might be more convinced to get one if she were shown usage comparisons with similar households whilst another participant believed that smart water meters might be helpful if they provided information on what works their water company was carrying out in the area, saying "really, you get no information about your water [at the moment]".

Finally, whilst one participant living in a two-person household felt that it would be useful to get an idea of where most water was being used in his home, another said that he already had a good idea of which appliances/fittings consumed most water and was therefore not sure that micro components of usage would be "ground-breaking information".

3.2 Group two: Metered participants

The second focus group was composed of five participants, although a sixth person was recruited for the group but did not attend. All five attendees were metered, with three on standard water meters and two on smart water meters. Henceforth referred to as the metered focus group, this category allowed for an exploration of people's expectations of a smart water meter as well as lived experiences with smart water metering. All participants were either solely or jointly responsible for paying their water bill. Participants in the metered focus group belonged in the 20-60 age range, and all lived in either a detached or semi-detached house comprising one to five people.

3.2.1 Attitudes towards and management of utilities

Members of the metered focus group were remarkably more engaged with managing their utilities than those in the unmetered focus group.

For instance, one participant who had a smart electricity meter at home and in a rental property, described closely tracking household consumption with the help of the meter, and claimed to have been saving "a bit of money" since installation. Another participant tracked his household's energy consumption using an online app despite intentionally not having a smart electricity meter, fuelled by other people's anecdotal accounts of difficulties faced when switching energy providers afterwards.

Overall, the metered participants were highly engaged with smart technology and could provide lots of examples of having incorporated smart tech into their homes. One standard metered participant described smart technology as "making life a lot easier", and according to someone already on a smart water meter, "that's the way the future's now going". Another participant said that:

"[Smart technology] does make you change your ways and become more innovative in your approach... You can have real savings and change habits".

All participants in the metered focus group appeared to be positive about and receptive to smart water metering and described themselves as actively trying to save water.

For instance, two participants on a standard water meter had water butts for their gardens, and the two participants who had a smart water meter were very positive about their smart meter motivating them to locate ways to save more water.

Further, a male in his forties, in a household of five people with a standard meter, had received a letter from his water company offering him a smart water meter, which he happily accepted, expressing that he felt that the smart water meter should be the default for all households. However, another participant with a standard water meter and living in a household of four people said that there was not much more his family could do to save water but was "fascinated by it [the smart water metering as he had] never heard about a smart water meter". He had looked online to find out about water efficient devices like cistern displacement devices and aerated showerheads and felt that his children would be interested in having a smart water meter as well because they had been learning about saving water at school.

3.2.2 Benefits: Lived experiences of smart water metering

Both participants on a smart water meter described themselves as using less water than previously and saving money while on a smart meter. Attesting to this, one smart-metered participant stated thus:

"The smart water meter is good because our water bills before were high and since we've had the smart water meter... they [the water bills] have actually gone down... It has made me think about every drop of water."

The smart-metered participant who gave the account above estimated that her current water bill was half of what it was before installing the smart meter. Another participant, living in a household of five, had noticed a dip in consumption, and an accompanying "slight savings" since switching from a standard water meter to a smart one. When shown the statement 'Smart water meters can help you lower your water bill', he replied thus:

"For me, it [smart water metering] makes complete sense because I've already embraced this type of technology."

A participant living in a household of five people argued that having a smart energy meter had allowed him to plan better and "keep on top of" his finances. For him, this had been the biggest benefit of having a smart energy meter, and he assumed that the benefit would be the same for a smart water meter. He said that although the main purpose of having the smart meter was to track household energy usage, not necessarily to save energy, he had still seen a "shift" in his energy bills, citing that:

"If I put on the washing machine twice a week, instead of three or four times, you can actually see the difference."

A participant already on a smart water meter, and living in a household of five people, found that the additional detail provided by having the smart meter meant that it was easier to split the bill accurately between himself and his wife. They had also benefited from receiving an email every three months which compared their water consumption over the previous quarters. Another participant who was not on a smart water meter felt that the ability to track his household's water consumption would be helpful to him in maintaining "the balance between what is essential water usage and what is waste water usage", and another female participant currently on a standard water meter agreed with the participant, highlighting that this reported benefit was "tempting".

A participant in her forties had also benefited from being able to track water consumption with her smart water meter, saying:

"Quite often, I pop under the stairs and make sure it's not going around when no water's being used."

According to the participant who gave the above account, checking the smart water meter alerted her to wastage on one occasion when she had accidentally left a garden hosepipe running. This capacity for leak detection was also appreciated by another participant and led another participant on the standard water meter to argue that the old Victorian water pipes should all be mended/ replaced "first" (before investing in smart water meters), although she acknowledged that if smart water metering could stop leaks, that would be "a help to everybody".

It is noteworthy that the environmental benefits associated with potentially using less water on a smart meter were more persuasive to the metered focus group than to the unmetered focus group. For instance, a female participant in her sixties and on a standard water meter felt that her "priority would be to save water for the environment", and another male participant in his forties and already on a smart water meter argued that:

"The [public] concern should be about saving more water and going more green."

Another participant thought that better environmental outcomes were a good benefit, although when shown the statement 'Smart water meters can help you to reduce your carbon footprint. Installing smart water meters nationwide could help save 0.5% of the UK's greenhouse gas emissions', he expressed that he was not sure how this carbon saving would happen. In contrast, another participant on a standard water meter felt that although a 0.5% reduction in greenhouse gas emissions did not sound a lot, this was still a powerful message, stating thus about the impact of such messaging:

"You'd feel like you're doing your piece to help... [the environmental benefits and reduction of carbon footprint] is the heavy hitter... very impactful, very current."

Like observed in the unmetered focus group, people in the metered focus group felt that the ability for a water company to take a remote reading of the smart water meter was of benefit to them. However, one participant was concerned that this meant people might lose their jobs, and so on balance viewed this element as a potential barrier.

3.2.3 Perceived barriers to smart water meters

For participants on a standard water meter who did not know how to access a smart water meter, or did not know what the benefits might be, this lack of awareness proved the biggest barrier.

The possibility of a higher water bill following the installation of a smart water meter was not a concern for people already on standard meters. A few other concerns relating to assumed costs were however raised, similar to assumptions already expressed by participants in the unmetered focus group. For example, at least one person not currently on a smart water meter assumed that there would be a cost involved in fitting one. Another concern was raised by a female participant who was standard metered about whether having one would use up electricity (and therefore raise electricity bills). To which another participant, who did have a smart water meter, responded that she'd never thought about that, and was now worried that her smart water meter was using excessive electricity. However she was reassured by a participant who was sure that his smart water meter did not use much.

A participant who had a smart electricity meter felt that sometimes data from the meter was delayed when he was having internet connectivity issues and assumed that the same problem might occur with a smart water meter, stating thus:

"When technology goes down, that can be a humbug."

Upon being shown the statement 'Smart water meters are not invasive to install', one participant who was on a standard meter could not envisage this, claiming it sounded "like it would be quite invasive". However, another participant already on a smart meter described the process of her own smart meter installation as convenient, stating that "it was easily installed, done very well and neatly" beneath her stairs, and another participant also confirmed that the installation went smoothly, and did not take more than an hour.

3.2.4 Final sentiment: motivation behind uptake

Upon realisation of the potential cost savings due to being on a smart water meter, a male participant on a standard water meter stated thus:

"Definitely after today, I'll start making enquiries... it feels like a no-brainer... I'd be very much interested."

Having not heard about smart water metering before, this participant recommended that smart water meters are advertised on social media so that more people become aware of them. The facilitator of the metered focus group then asked what other methods of raising awareness might work well, to which a standard-metered participant expressed that water companies should be more proactive in promoting smart metering, and another participant agreed, rhetorically asking:

"If I had to make contact [with my water company to ask for a smart water meter], would I do it? As opposed to them offering it to me?"

In the same light of highlighting the necessity of water companies to take a proactive approach in offering smart water meters to people, another male participant in his forties, already smart-metered, suggested setting up stalls on high streets and in shopping centres so that people like his parents might find out about a smart water meter face-to-face.

3.3 Agency recommendations for increasing uptake

Based on the findings from these focus groups, Directions Research and Marketing put forward some recommendations for increasing public appetite for and uptake of smart water meters.

These recommendations centre largely around effective communications which proactively engage residents on the existence and benefits of smart water meters, with the agency emphasising that people tend not to be thinking a lot about their water supply and so will not seek out the information by themselves.

It was highlighted that ensuring that residents understand that they could save money by installing a smart meter would be the most important element of communication, including providing them with a realistic context of how much money their household could save. The more specific these benefits can be to the household, the better. For example, sharing case studies of households of the same size and how much money they saved by switching to a smart water meter.

For those households that are less likely to save money on their water bill by switching to a smart water meter, communications focusing on the smart water meter's ability to help them track their water use and budget for it was recommended. Indeed, for those residents not on a water meter who feel a – sometimes frustrating – lack of control over their water bills (as opposed to their other utilities, for which they could switch supplier), the opportunity to advocate for smart water meters as giving them more control over their water management was emphasised.

Reassurances on the ease of installation and usage, and the convenience of remote readings, were also envisaged as helpful. Specifically, clearly communicating that the smart water meter and its installation will be free is likely to be beneficial. Because several participants expressed the desire for a trial period, the ability to offer this may prove very persuasive. Whilst it emerged that the environment was not the primary concern for most participants in the focus groups, communications around environmental benefits was recommended as good supporting information that can create a win-win motivation for uptake.

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About the authors

Waterwise was founded in 2005 and is the leading authority on water efficiency in the UK. It is an independent, not-for-profit organisation and its vision is that water will be used wisely, every day, everywhere.

Waterwise works in a range of areas including: influencing and shaping policy and legislation; driving strategic and practical ambition in the water sector; designing and delivering research; media, campaigns and promotion; running demonstration projects; promoting water efficient technology; helping businesses be more water-efficient; facilitating partnerships; brokering new solutions; and training water efficiency practitioners.

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Arqiva is a communications infrastructure and media services company, operating at the heart of the broadcast and utilities industries in the UK.

Arqiva builds and monitors the digital infrastructure which facilitates the operation of smart water networks, through its dedicated and secure radio network. In addition, Arqiva has a growing portfolio of complementary services designed to support both water companies and consumers to manage water use and minimise leakage and also address issues across the network from clean water generation through distribution to waste water and sewage.

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Appendix 1: Survey

Public attitudes towards smart water metering: survey questions

Q1 Are you responsible for paying the water bill in your household?

Yes

No

Q2 Please enter the first four letters/numbers of your postcode

[enter]

Q3 What type of property do you live in?

Detached house

Semi-detached house

Terraced house

Bungalow

Flat/Maisonette

Other

Q4 How many people are there in your household?

1

2

3

4

5

6 or more

Q5 How old are you?

18-24

25-34

35-44

45-54

55-64

65+

Q6 **Are you aware of the pressure on the UK's water supply and the need to protect our water resources? Please select the answer that most applies to you**

No, I hadn't heard about this

I think this applies to other countries, but not to the UK

Yes, I'm aware but I don't know much about it

I'm aware that we need to be saving water, but I'm not thinking about it day-to-day

I'm aware that we need to be saving water, and my household regularly tries to do so

Q7 **A water meter measures the amount of water that a household uses over a period of time, so that the household is charged only for what it uses. Is your household on a water meter?**

Yes

No

I don't know

Q8 **If your household does not have a water meter, why not? Please select all reasons that apply [seen only by those who answered 'no' to Q7]**

I would like to have one, but can't for practical reasons (e.g., live in a flat)

I would like to have one, but haven't gotten around to it

I would like to have one, and I'm waiting for my water company to offer me one

I don't want one because I'm concerned that my water bill would go up

I don't want one because I'm concerned that fitting it would cause disruption

Other [please specify]

Q9 **A smart water meter allows you to track the amount of water you are using in real time, giving you visibility and control over your water use. If your water company were able to provide you with a smart water meter for free, and you wouldn't need to do anything, how likely would you be to object to this?**

Very unlikely

Somewhat unlikely

Not sure

Somewhat likely

Very likely

I already have a smart water meter

Q10 What, if anything would stop you from wanting a smart water meter? Please select all that apply

I would be concerned that there would be disruption in getting it installed

I would be concerned about it involving a lot of effort on my part

I would be concerned about my water bill going up

I would be concerned about the reliability and/or accuracy of the technology

I would be concerned about my data being stored or shared

Nothing would stop me from wanting one

Other (please specify)

Q11 On average, households who have switched from being unmetered to smart metered use 17% less water than before. Using less water helps to protect our water resources and reduce greenhouse gas emissions (due to the energy used in cleaning and pumping water through the network, as well as in heating water in the home), as well as potentially lowering the cost of the household water bill. Smart meters can also help to detect leaks in your home. Please select the three biggest benefits that you personally would get from a smart meter.

I think my water bill would go down because I would use less water

I would be able to track my water use, giving me more control over it

It would alert me to leaks

It would be more environmentally friendly because I would use less water and reduce my carbon footprint

My water bill would be more accurate

I would not be paying for water while away from the home (e.g., on holiday, for work)

It is only fair for everyone to pay for the amount of water that they use

There are no benefits that would persuade me to get a smart meter

Q12 What 'smart' technology do you currently have in your household, if any? Please select all that apply

A smart water meter

A smart phone

A smart energy meter

An Amazon Alexa or similar

A smart doorbell

A smart security system

Other [please specify]

I don't know what smart technology is

I don't have any smart technology in my home

Q13 If you already have a smart meter installed, please let us know your experience with it by ticking all answers that apply. [seen only by those who answered 'I already have a smart meter' on Q9]

I have a smart meter and it helps me to track my water consumption

I have a smart meter and I have reduced my water consumption since getting it

I have a smart meter but have noticed no difference in the way I use water

I have a smart meter and would recommend it to others

I have a smart meter and I would not recommend it to others

I have a smart meter and it has been beneficial to me

I have a smart meter and it has not been beneficial to me

Q14 If you found out your friends, neighbours or family members had a smart water meter would it make you more likely to want one installed?

Yes, definitely

Possibly

No, it wouldn't influence me

Q15 If you knew that having a smart meter installed would lead to a reduction in your bills and that it would be fitted at no charge, how likely would you be to look into getting one?

Very likely

Somewhat likely

Somewhat unlikely

Very unlikely