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SMART WATER METERING: MAKING THE RIGHT DECISIONS

A paper by Frontier Economics and Artesia Consulting

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Executive summary

Most of the England and Wales water companies have submitted plans to Ofwat as part of PR24 that include significant investment in smart water metering. Over the next 12 months Ofwat will be scrutinising these plans and deciding which investment programmes to support and what is the efficient cost allowance for these programmes. At the same time companies will be refining their proposals, and considering the right smart metering solution to deploy.

Arqiva (a technology and managed communications service provider rolling out smart water metering in the UK) has asked Frontier Economics and Artesia to produce a short paper that evaluates the risks and opportunities around these important decisions.

These investment plans are vital to meet the ambitious targets for reducing water demand in the face of climate change and population growth, with government having set 2038 targets of 37% leakage reduction, consumption reduction to 122 litres per person per day (from the current level of 145 litres) and a 9% reduction in non-domestic consumption.

There are a range of smart metering solutions, i.e. those considered to be Advanced Metering Infrastructure (AMI), and these have a spectrum of capabilities. This can drive a considerable range of benefits to customers, water companies and the environment. However, at the current time, and unlike in energy, there is no defined smart metering standard in the water sector, which means there is no common definition for the performance of a smart water meter.

Solutions with greater functionality and capability can deliver greater benefits, but potentially at higher cost than alternatives. For smart metering to deliver demand savings, customer and operational improvements which are transformative, sustained and maximised, then data and the insight that can be derived from it needs to:

- Be timely;
- Provide sub-daily consumption patterns;
- Be available over a wide area i.e. high degree of property coverage; and
- Provide reliable data returns to customers and the water company from a high proportion of the installed meters.

Reductions in capability across these dimensions can have considerable impact by reducing the potential for benefits to materialise. Building on analysis undertaken in our previous report[1], we have estimated how the benefits from smart metering can vary depending on the functionality of the AMI solution. This is shown in the table below, the scenarios with lower functionality for the AMI solution will only deliver between 50% and 67% of the benefits of the highest performing AMI solution.

[1] Frontier Economics and Artesia Consulting, Unlocking benefits through data and metering, May 2022: https://www.frontier-economics.com/uk/en/news-and-insights/news/news-article/?nodeId=9279

Table 1 Scale of benefits depends on AMI functionality

Scenario	A	B	C
Description	Hourly data, daily data return, high coverage and read success	Daily data, weekly data return, medium coverage and read success	Daily data, monthly data return, low coverage and read success
Total benefits	£4,137	£2,782	£2,058
% of high performance AMI	100%	67%	50%

Source: Frontier Economics and Artesia Consulting

As Ofwat assesses the companies' investment plans it will need to be careful and consistent in how it compares the different proposals:

- First, a material proportion of the costs will be specific to the metering solution proposed and therefore will be challenging for Ofwat to benchmark.
- Second, the difference in benefits and associated costs of different technology solutions, means that they need to be evaluated in an integrated way to avoid the risk of setting an infeasible outcome by combining the costs of one solution with the benefits from another.
- Third, smart metering data will play a vital role in delivering Ofwat's aspirations for the water efficiency fund, as well as supporting vulnerable customers. Understanding the level of performance that companies are expecting from their smart metering plans will be important for Ofwat to be confident that their objectives in these areas can be met.

From the point of view of water companies, technological lock-in means they should consider:

- Whether the technology solution being developed can deliver the benefits required from smart metering over the next 15 to 20 years.
- Whether it delivers the optionality to meet future challenges and more extreme scenarios.
- Whether the solution will meet current and future regulatory expectations for customer engagement on water efficiency and also support for vulnerable customers.

When setting out their investment plans, companies could define the level of performance they are expecting from the smart water metering systems they plan to deploy, and when that level of performance will be delivered.

Given the early stages of deployment of smart water metering and the increasing challenge that water companies will face in meeting the ambitions that have been set out, there is merit in considering these issues in the context of Ofwat's adaptive planning framework and the potential for delivering a consistent and good level of customer experience, to encourage customer engagement with the technology.

1 Introduction

Most of the England and Wales water companies have submitted plans to Ofwat as part of PR24 that include significant investment in smart water metering. Over the next 12 months Ofwat will be scrutinising these plans and deciding which investment programmes to support and what is the efficient cost allowance for these programmes. At the same time companies will be refining their proposals and considering the right smart metering solution to deploy.

Arqiva has asked Frontier Economics and Artesia to produce a short paper that evaluates the risks and opportunities around these important decisions.

This paper is structured as follows:

- Section 2 describes the significance of smart metering in the context of PR24 and the longer-term challenges faced by the industry;
- Section 3 considers how smart water metering is an evolving and competitive environment with different solutions and functionality being considered, albeit with only one solution deployed at scale;
- Section 4 evaluates how the benefits case for smart metering depends on the specific AMI solution; and
- Section 5 concludes and considers the key questions that companies and Ofwat should be addressing to ensure the right decisions are made.

2 Smart metering in the context of PR24

There are ambitious plans for investment in smart metering

The National Infrastructure Commission (NIC) produced their second national infrastructure assessment in October 2023 and this highlighted the importance of managing the risk of drought in England, through early and urgent action.[2] As the climate changes, the population grows, and pressures on the environment increase, England will need to better manage its water supply infrastructure. The NIC recommends a twin track approach to drought resilience — increasing supply and managing demand. It estimates that there will be a gap of 4,000 megalitres per day (Ml/d) between supply and demand by 2050, which is currently around 30% of the water currently put into public supply. To close this gap the NIC suggests:

- 1,300 Ml/d to be supplied by new reservoirs;
- 1,400 Ml/d to be saved by reducing leakage (halving leakage by 2050);
- 1,400 Ml/d to be saved by reducing consumption in households and non-households (reducing per capita household consumption to 110 litres per head per day, and reducing non-household consumption by 15% by 2050).

These aspirations for reducing demand are echoed in the Government's Plan for Water,[3] which sets intermediate targets for 2038 as follows:

- Leakage to be reduced by 37%;
- Household consumption to be reduced from current 145 litres to 122 litres per head per day; and
- Non-household consumption to be reduced by 9%.

Achieving these targets will reduce total demand per head of population by 20%. To support the continued reduction in water demand, Ofwat is also consulting on a £100 million water efficiency fund for 2025 to 2030, to stimulate a transformative, sustained and measurable reduction in water demand nationally.[4] A previous report by the NIC highlighted the risks and potential impact of not taking action in this area, estimating that it would cost £40 billion over the next 30 years, relying on alternative emergency options to address droughts[5].

A key part of the water efficiency fund consultation discusses the role that smart metering will have in reducing leakage and consumption. A significant proportion of these savings will need to be driven through the data provided by smart meters, which would provide insights into

2 See https://nic.org.uk/studies-reports/national-infrastructure-assessment/second-nia/.

3 See https://www.gov.uk/government/publications/plan-for-water-our-integrated-plan-for-delivering-clean-and-plentiful-water.

4 See https://www.ofwat.gov.uk/consultation/scoping-the-water-efficiency-fund-high-level-consultation/.

5 See https://nic.org.uk/app/uploads/NIC-Preparing-for-a-Drier-Future-26-April-2018.pdf.

water use by companies and customers. This can be used to reduce leakage and losses in under-ground pipes and in the water-using devices that exist in buildings. It can unlock different ways of communicating with customers, supporting them to reduce their water wastage and water use. It can also form the basis for structuring innovative tariffs that support vulnerable users, and provide incentives to reduce wasteful consumption, for example in peak weather periods.

Data from smart meters can also be used to deliver broader benefits, such as supporting vulnerable customers. This is an area where Ofwat has provided new vulnerability guidance[6] on providing a high standard of service and support for vulnerable customers, developing services that are inclusive by design, identifying customers who need extra help, and developing and implementing vulnerability strategies.

Smart metering can deliver a range of benefits

While there is no agreed definition of smart metering, there are a range of solutions, with a spectrum of capabilities, in terms of the data performance that they deliver. This mainly relates to the frequency at which data is recorded (e.g. hourly sampling of consumption) and transmitted to the water company (e.g. daily reporting), the proportion of properties covered, and the reliability and consumer friendliness of the solution. These differences in capability determine the potential for delivering benefits.

At one end of this spectrum, Advanced Metering Infrastructure (AMI) can communicate vast amounts of metering data remotely and automatically, enabling the greatest level of total benefits. At the opposite end, Automated Meter Reading (AMR) relies on an operative driving or walking by kerbside water meters. In practice, the economics of AMR solutions mean that they have a fairly narrow range of capability. By comparison, the capability of an AMI solution will vary depending on the solution that is adopted.

This spectrum of capability means that smart metering can deliver considerable benefits to customers, water companies and the environment, beyond basic cost reductions related to meter reading and billing. Solutions that are able to provide more frequent and granular data, enable greater benefits, such as helping detect leaks and influencing customer behaviour towards lower water usage. This improves water network management, avoids greenhouse gases (e.g. related to water pumping, water heating) and saves customers money.

In a previous paper, Frontier Economics and Artesia Consulting[7] assessed the potential costs and benefits related to each technology and found that AMI and AMR technologies offer materially different levels of net benefits, depending on the level of companies' ambition to deploy smart metering data, in their operations. Importantly, the report also found that the potential range of benefits related to AMI solutions is broad, and in practice is driven by the

6 https://www.ofwat.gov.uk/ofwat-sets-out-new-rules-to-protect-vulnerable-customers/

7 Frontier Economics and Artesia Consulting, Unlocking Benefits Through Data and Metering, May 2022: https://www.frontier-economics.com/uk/en/news-and-insights/news/news-article/?nodeId=9279.

precise capability of the solution, to deliver more frequent and granular data. In this paper, we focus more on the implications of this range of capability in AMI solutions.

The previous report monetised the following benefits:

- Water consumption and leakage savings;
- Carbon savings;
- Infrastructure cost savings; and
- Reduction in meter reading, forecasting and associated costs.

In addition, the study identified further non-quantified benefits that customer and water companies would value:

- Better customer engagement and satisfaction;
- Nudging customer behaviour;
- Wider network development options and spill-overs; and
- Innovation in tariffs and customer insight.

We also note that a key benefit of AMI relates to the option and flexibility for water companies to adapt to future challenges. This can relate to insight and tools for better engagement with customers and behavioural nudging. More generally, AMI can offer network spill-over effects in the future, given its level of connectivity. In line with the spectrum of system capability mentioned above, the potential for these benefits would be driven by the scope of the particular solution commissioned by water companies.

What are the next decisions to be made?

Important decisions in relation to the metering programmes will be made over the next 12 months or so.

As outlined above, the water companies have submitted their business plan proposals to Ofwat, and Ofwat is currently in the process of analysing these. This will involve comparing the costs and benefits of each programme, both against each other and against previous smart metering decisions. Based on this evidence Ofwat will decide (in the draft PR24 determination due in May or June 2024 and then the final PR24 determination in December 2024):

- Whether to allow the metering investment programmes for each company; and
- Where the programmes are included in the Determination - what is the cost allowance for the programme (based on an assessment of efficient costs); and what will the programme deliver in terms of outcomes for customers.

During this period, the water companies will be continuing to refine their metering programmes; e.g. considering the phasing of the roll-out, engaging with suppliers around

deliverability, and considering whether and how internal processes need to adapt, in order to secure the benefits.

Choices around metering technology

Choices around metering technology will generally determine the quality and quantity of data used to deliver benefits for customers as well as the proportion of metered homes which provide regular data. As a result, the way in which companies approach their smart metering programmes would determine short and long-term outcomes.

A useful framework for considering these choices and the potential outcomes, is one around water companies' ambitions for the deployment of data, in comparison to the capability of the smart metering solution. Company ambitions can be considered as follows – we expect that these would grow with the evolution of smart meter deployment across the industry:

- **Low ambition:** At the lowest level of ambition, companies would use smart metering with the aim of increasing meter reading cost efficiency. Aside from these cost saving, customers and companies may experience some incremental consumption reduction, as a result of improved billing and accuracy.

- **Medium ambition:** A higher level of metering ambition moves companies' focus to using data to unlock consumption and leakage benefits. Companies would use some data insights, to engage further with customers around their consumption, alongside using network data to better manage leakage.

- **High ambition**: Companies would begin to fully utilise the power of data and insights from metering, to deliver customer outcomes and resilient services. This approach would integrate consumer insight from metering into various processes, improving network resilience and applying innovative solutions such as flexible tariffs.

Using this framework, we previously estimated that AMI could deliver between £1.3bn and £2.2bn of net benefits[8] compared to AMR across England and Wales, depending on just how ambitious the companies are in making full use of the additional data, based on companies deploying AMI metering solutions with reasonably high specification. The results from this study are summarised in Table 1 below.

[8] All benefit estimate figures in this paper are presented in Net Present Value (NPV) terms, over 2021/22 to 2050/51.

Table 2 Benefits of AMI increase with ambition (2022 study results)

Level of company ambition	Description	Net benefits	Benefit-Cost Ratio (BCR)
Low ambition	Companies focus on increasing cost efficiency of meter reads	£1,283m	1.56
Medium ambition	Companies focus on demand and leakage benefits	£1,862m	1.82
High ambition	Companies aim to maximise data benefits from metering	£2,184m	1.96

Source: Frontier Economics and Artesia Consulting

The analysis assumed that AMI solutions collect hourly meter data, which is transmitted to the water company daily and that a very high proportion of the installed meters provide regular data. The corollary of the benefits estimates in the paper, is that if companies deploy less capable AMI solutions in terms of data delivery, or property coverage, this would reduce the benefits that could be attained.[9] This is a key issue, which we explore in more detail in Section 4 of this report, where we also provide a framework for understanding the main performance dimensions of smart metering, and key drivers of benefits.

The extent to which outcomes can be achieved in line with companies' ambition, depends on the capability of the smart meter solution chosen. This extends beyond the choice between AMI and AMR but also to different AMI solutions with different levels of functionality. The level of benefit associated with different system capabilities will vary. Overall, we there will be a clear variation in the system costs and potential range of benefits, when comparing different solutions with different levels of functionality:

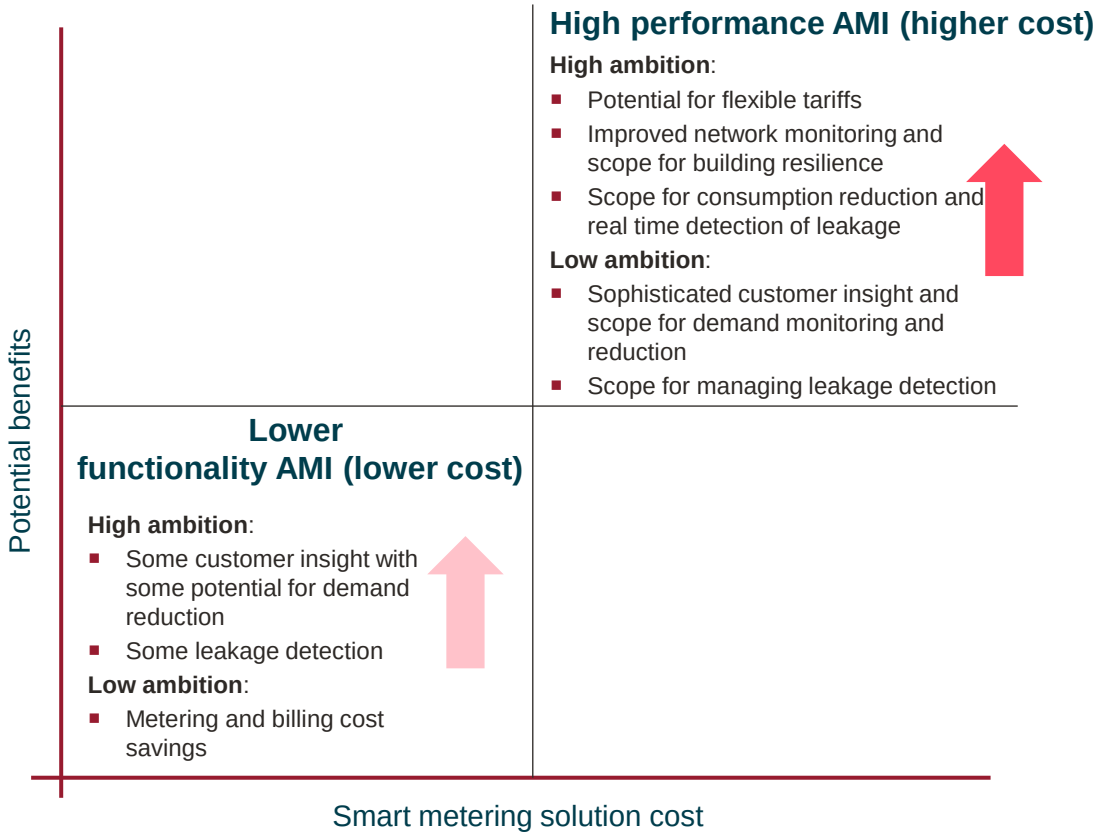
- **Solutions with greater functionality may require a higher cost**. There are additional costs associated with commissioning a high capability AMI solution and utilising the data it generates, compared to an AMI with lower functionality (or an AMR solution).
- **Potential range of benefits varies significantly**. There are several dimensions of AMI system capability. AMI solutions with low functionality and property coverage (e.g. where a relatively high proportion of meters might not be capable of providing regular data), are unable to unlock the full benefits of smart metering and could offer benefit levels that can be closer to those achieved with an AMR solution. It is also important to consider net benefits over the longer term, as higher capability solutions, which have potential to deliver greater benefits may have greater costs.

We illustrate this as a spectrum in Figure 1 below. This has an important implication, as it is not feasible to achieve the benefits of a high capability and high property coverage / high

[9] Frontier Economics and Artesia Consulting, Unlocking Benefits Through Data and Metering, May 2022.

proportion of meters providing data AMI system, by a lower performance and lower cost solution. This also has implications for technology lock-in, if a company finds itself locked into a solution that does not deliver the performance required to meet its delivery ambitions.

Figure 1 Comparison of potential costs and benefits of different solutions



Source: Artesia Consulting, Frontier Economics

Note: Comparison focuses on the range of capability, costs and potential benefits within the spectrum of AMI solutions. AMR solutions would yield lower benefits than those shown and may be achievable at lower costs.

Therefore, companies would be well-advised to consider at the outset, the extent to which deployment of high-quality data where a very high proportion of meters provide consistent data could be important in the medium to long term. This also has important implications for the decisions faced by Ofwat, in relation to assessing smart metering business cases. We explore these further, in Section 5 of this paper.

3 Water metering is in its early stages

There is no agreed standard for smart water meters

In contrast to energy smart metering, there is no agreed standard for smart water meters and their communication systems. This means that there is no standard for key performance factors, which include coverage, frequency of data returns, granularity of data and interoperability.

Two water companies have pioneered the roll-out of smart water meters in England & Wales (Thames Water and Anglian Water). Both have chosen to use a smart metering approach that:

- Collects hourly consumption data;
- Sends that data back to a meter management system daily (up to 6 times per day) over a private radio network; and
- Aims to get data back from at least 97% of the installed smart meters reporting every day.

This (high) level of functionality was used to develop the cost benefit case for AMI[10] metering, reported previously by Frontier Economics and Artesia Consulting.[11] By 2025 we expect there to be at least two million of this type of meter being deployed and sending back data. Nevertheless, given that there is not currently a common standard or definition, there is scope for different levels of functionality of smart metering to be adopted by water companies.

There are different AMI solutions

Water companies have submitted plans for increased levels of smart metering in their business plans for the period 2025 to 2030, and in their water resource plans. While the plans provide information on meter numbers, costs and benefits, there is very little information on the technology or the specification of the data that will be available.

As we detailed earlier in this paper, AMI solutions have a spectrum of capability and can deliver different levels of performance. For example, several companies propose “AMI ready” meters being installed in AMP8 but operated in “AMR mode”. Some companies also talk about using a LoRaWAN radio network.

The difference in data richness and frequency of output, for these meters, would vary greatly. For example, in contrast to the AMI solution adopted by Thames and Anglian Water above, some lower performance AMI metering solutions could reasonably be expected to only send

10 Smart meters are often referred to as AMI or advanced metering infrastructure.

11 Frontier Economics and Artesia Consulting (2021), The Benefits of Smart Metering in the Water Sector.

consumption data on a monthly basis, and/or cover or collect data from a proportion of properties served by a water company or where a smart meter is installed.[12]

Therefore, there is the potential for metering solutions to have different performance and reliability with respect to data delivery, frequency and granularity of data. This means it becomes important to understand the potential impact this has on the benefits case, which may be improved or reduced.

Timing and least-regret decision making

Given the asset lives of the technologies used for the communications infrastructure, the decisions made in relation to the technology solution will be 'locked in' for a period of 10 to 15 years, if not longer. These decisions will play an important role in defining the level of benefits that can be achieved from smart water metering over this period which, as outlined in Section 2 above, is a crucial period for the water sector in meeting the challenges it faces.

In defining their investment programmes for PR24, Ofwat expects the water companies to consider how options perform under different future scenarios. Ofwat's guidance states that companies should use an adaptive planning framework to assess the optimal investment programme.

Ofwat guidance on adaptive planning

Ofwat's guidance on Long-term Delivery Strategies[13] sets out that adaptive planning must be at the heart of the strategy. Adaptive pathways help to show what is required in most or all future scenarios.

This assists in choosing the optimal profile of investments, ensuring that decisions are not avoided when they are needed, and at the same time minimising the risk of stranded assets.

The core pathway includes all activities that need to be undertaken to meet all plausible scenarios and should satisfy the following criteria:

- 'no and/or low regrets' investments, for example investments that are required across a wide range of plausible scenarios; and
- investment required to keep future options open (such as enabling work).

This approach should be applied to the decision of smart meter technology solution, recognising that the decision will be 'locked in' for a period of time. Therefore, the following considerations are important:

12 In contrast to AMI, AMR meters would deliver less frequent data returns, and lower benefits. AMR solutions could reasonably be expected to collect only average weekly consumption data, along with a leak flag, and be read only twice a year. This is the AMR performance assumed in the Frontier report.

13 Ofwat, PR24 and beyond: Final guidance on long-term delivery strategies, April 2022.

- Does a 'low functionality' solution meet the needs of the company under the core scenario for the entire life of the investment?
- Does a 'low functionality' solution meet the needs of the company under all plausible scenarios?
- Would a 'low functionality' solution engage individual customers and offer them a good customer experience?
  - Would the customer experience promote engagement with the company's smart metering and resource savings programmes?
  - Will the solution meet current and future regulatory expectations for customer engagement on water efficiency and also support for vulnerable customers?
- If the 'low functionality' solution does not satisfy these tests:
  - What additional costs would be incurred to upgrade the functionality of the existing solution before the end of its planned asset life (i.e. the costs of stranded assets)?
  - How does this compare to the additional costs of a 'higher functionality' initial solution?
- What additional optional benefits would a 'higher functionality' solution deliver to allow a company to be resilient in the face of more extreme scenarios?

An understanding of these considerations is important to defining an appropriate solution under an adaptive planning framework.

4 How AMI solution performance links to benefits

In this section we consider how performance of the smart metering systems can impact delivery of the benefits we discuss earlier in this report. We turn to leakage and household water efficiency first.

Leakage reduction benefits can be delivered through:

- **Identifying and fixing underground supply pipes.** Continuous flows from smart meters indicate potential underground supply pipe (USP) leakage. The distribution of these leaks across the network is random, and there tend to be a relatively small number of very large leaks, with a larger number of weeps and seeps. Therefore, to improve the chances of capturing the largest leaks it is important to have the highest possible coverage of smart meters. In the early stages of smart meter rollout, the frequency of data return could be less important as the leaks are detected and repaired. However, as leakage reduces, there will be an increasing need to detect USP leaks quickly to reduce leak run times, meaning that daily, or more frequent, data returns will be necessary to reduce and maintain a low level of leakage on USPs, in the long run.
- **DMA water balances.** DMA water balances using smart meter data can lead to more accurate quantification of leakage at DMA level, which will allow improved targeting of leaks. This requires high coverage of household and non-household properties, returning hourly flow data. Ideally data returns should be daily, so that the DMA water balances can be carried out in near real time as required. The accuracy of the DMA balances will improve as the proportion of properties returning smart meter data increases.
- **Non-household night use.** To allow accurate leakage quantification and reporting, large commercial properties are metered and logged at 15-minute intervals. These are netted off the DMA night flow to reduce the impact of significant night use in the DMA. As smart meters are rolled out on non-household properties, these could replace the need for specific meters and loggers and could increase of the proportion of non-household night use removed from the DMA night flow. This would require a minimum of hourly data, to be returned at least daily.

Household water efficiency benefits can be delivered through:

- **Identifying and fixing wastage.** Continuous flows from smart meters indicate potential wastage from plumbing systems and water-using devices (for example leaking WCs or leaking plumbing). Reducing or eliminating these has a positive impact on the customer as bills are reduced, without a reduction in utility. The distribution of wastage events across households is difficult to predict. Therefore, to improve the chances of the capturing the largest wastage events, it is important to have the highest possible coverage of smart meters. In the early stages of smart meter rollout, the frequency of data return could be less important as the wastage events are detected and repaired. However, as leakage reduces, there will be an increasing need to detect wastage events quickly to

reduce run times of losses on plumbing systems, meaning that daily data returns could be necessary to reduce and maintain a low level of wastage, in the long run.

- **Behaviour change.** Encouraging consumers to reduce their personal consumption, will be improved using smart meters, by allowing consumers to see and understand their consumption patterns, and by using the insight from consumption patterns, to offer tailored advice or services. For this to be most effective, consumption patterns throughout the day and comparison between days will be needed – ideally with near real time feedback to customers.
- **Innovative tariffs.** Structured tariffs could be used to drive behaviours and curb wasteful water use. For these to be effective, smart meter data is essential. It will also allow companies to design tariffs, which are inclusive and do not penalise specific types or customer, for example vulnerable customers. Trials are being planned by companies in AMP8 to investigate a range of potential tariffs, such as rising block and seasonal tariffs. These will require high coverage, sub-daily granular data, with data being accessible on at least a daily basis.

The benefits listed above also apply to non-household users. In addition, sub-daily granular data will also help some non-household customers to optimise their water use in processes.

Improving customer services (household and non-household) will also be supported by the insight gained from smart meters. For example, this could include spotting potential leaks, or providing tailored services to support vulnerable customers. To maximise the impact of these, data will need to be granular, timely and with wide coverage. In relation to the latter specifically, smart meter rollout needs to have wide coverage of households and non-domestic sites, and a high degree of reliability in relation to the data returned by the meters, and accessed by the customer.

Smart meter data will also be used to help manage the water network, for example: helping to identify areas for asset replacement, managing customer demand in critical periods such as peak summer demand events, or managing customers' water use during interruptions to supply. To deliver these benefits, data will also need to be granular, with high coverage and near real time.

In summary, for smart metering to deliver demand savings, customer and operational improvements which are transformative, sustained and maximised, then data and the insight that can be derived from it needs to:

- Be timely;
- Provide sub-daily consumption patterns;
- Be available over a wide area i.e. high degree of property coverage; and
- Provide reliable data returns to customers and the water company, i.e. installed meters are fully commissioned and returning data.

Any reduction in capability of a meter system against this these criteria, could reduce its benefits. This is something that the MOSL Strategic Panel has also recognised and is addressing through adopting a definition for smart AMI meters[14], which sets out the need for 'SmartAMI' meters to be commissioned and providing a minimum level of performance. Table 3 shows how the level of benefit achieved could decrease, as some of the requirements on smart meter data are relaxed, from current best in class through to the lowest benefits (in this case, an AMI solution with lower data capability, property coverage and performance). We note that these scenarios assume that smart metering programmes are rolled out successfully in accordance with their specifications, and the system performs reliably, with customers receiving a good level of service.

Table 3 Change in benefits with variation in smart meter data requirements

	Level of benefit		
Smart meter requirements	**Highest**		**Lowest**
Scenario	**A**	**B**	**C**
Granularity of consumption data	Hourly	Daily	Daily
Frequency of data return (how often data is sent back)	Daily	Weekly	Monthly
Coverage (% of meterable properties)	95%	50%	30%
Proportion of reads returned (%)	90%	75%	50%

Source: Artesia Consulting, Frontier Economics[Insert Notes]

We use the smart meter scenario variation in Table 3 to assess the benefits of each of the scenarios. Scenario A represents the performance and coverage used in our previous benefits analysis. In that study we also defined benefits for AMR meters (having very low granularity and data performance compared to AMI). To calculate the range of benefits for smart metering in scenarios B and C by assessing where they sit between these two levels of performance for each of the key benefits for smart metering. These are shown in Table 4. The bottom line in the table provides the anticipated benefits for each technical specification.

[14] https://mosl.co.uk/news-and-events/calendar/events/metering-committee-meeting-33

It shows that scenarios B and C would be expected to deliver substantially lower benefits[15] than scenario A.

- Scenario B would deliver 67% of the benefits of scenario A (£1,355m less in total); and
- Scenario C would deliver 50% of the benefits of scenario A (£2,079m less in total).

Table 4 Indicative level of benefit with variation in smart meter data requirements (£m NPV 2021 prices)

Benefit type	Scenario A	Scenario B	Scenario C
More efficient leakage delivery	£151	£78	£62
Consumption savings – consumption costs	£453	£297	£234
Consumption savings – avoided capacity costs	£1,303	£846	£663
Consumption savings – Lower carbon emissions	£1,062	£641	£473
Reduced meter reading costs	£888	£782	£517
Improved infrastructure management	£181	£54	£54
Improved forecasting data	£99	£85	£56
Total benefits (£m)	**£4,137**	**£2,782**	**£2,058**
% of benefits of high performance AMI	**100%**	**67%**	**50%**
Reduction in benefits compared to high performance AMI (£m)		**-£1,355**	**-£2,079**

Source: Frontier Economics AMI evaluation 2022, additional analysis by Frontier and Artesia

In addition, our 2022 report highlighted that there are additional unmodelled benefits that AMI deliver or greater optionality to respond to future challenges. The extent of these additional benefits will also depend on the functionality of the AMI solution (i.e. between scenarios A, B and C).

- **Better customer understanding and engagement.** Depending on the frequency and granularity of information obtained from meters, water companies can develop a better understanding of usage patterns, impacts of weather and other aspects of customer use. Due to the higher frequency of reads enabled by full AMI, companies are also better able

[15] In NPV terms, over a 30 year period.

to target BAU customer activities such as water efficiency visits and supporting vulnerable customers.

- **Behavioural science and nudging.** There are a number of other experimental benefits also enabled by the more frequent data provided by AMI meters, such as behavioural nudges linked to customer insight. Future advancements in other emerging technologies, such as internet-enabled appliances and household automation may also enable communication between AMI meters and other technologies to foster increased automation and optimise water usage.
- **Wider network options and spill-overs.** The use of a network allows for scale beyond just household meters, enabling potential spill-over benefits from available network capacity, to capture and relay data from non-household and wastewater network meters. Optionality around future network data integration is high, as the marginal cost of connecting other meters to the fixed network is lower than alternative options.
- **Innovative tariffs and customer insight.** Greater and more timely information on water usage could also enable innovation in charging and tariffs. More frequent data via AMI meters could permit a much wider and flexible range of tariff options to be introduced in the future, such as time-of-use tariffs, peak demand tariffs and drought resilience tariffs. The optionality to create innovative tariffs is likely to have a positive value, as such tariffs will likely to deliver greater consumption reductions and protect the resilience of water supplies.

5 Ensuring the right decisions are made

As described above, at the time of writing, Ofwat is analysing water companies' business plans and their smart metering proposals. At the same time, the water companies will be refining their proposals, including considering the right smart metering solution to deploy. Our evaluation above poses important questions for both parties.

As Ofwat's decision will involve comparing the costs and benefits of each programme – against each other, and against previous smart metering programme decisions, there are implications for the approach Ofwat takes. There are also implications for the way in which companies present the business case of smart metering programmes and their decision-making criteria.

We turn to the issues from Ofwat's perspective first, before considering issues faced by water companies.

Ofwat position on smart meter investment

Ofwat has stated that it would expect smart meters as the standard installation going forward:

> *"Consistent with the UK government expectations for water resource planning we expect all companies to consider smart meter solutions as the standard meter installation type."*[16]

In addition:

> *"Companies should maximise the benefits available from technology and opportunities to collect increasingly detailed demand data on a near real time basis. We expect companies to provide detailed metering business cases to justify their proposed meter technology, the pace of delivery, the level of smart meter penetration they consider to represent 'full' smart penetration, and details of how they will support customers, including vulnerable customers."*[17]

While Ofwat would not look to prescribe any specific technology solution, at PR24, it is clearly asking water companies to consider the suitability of solutions with capability for a high degree of automation and data granularity:

> *"Companies should consider the benefits of increasingly detailed demand data that can be read without directly accessing the meter and provided on a near real time basis. Companies should provide sufficient and convincing evidence for the smart metering technology they propose to adopt. Where companies propose to continue to install older visual read meter technologies, they should provide compelling evidence to justify this."*[18]

16 Ofwat, Creating tomorrow, together; Our Final Methodology for PR24, page 88.

17 Ofwat, Creating tomorrow, together; Our Final Methodology for PR24, Appendix 9, page 73.

18 Ofwat, Creating tomorrow, together; Our Final Methodology for PR24, Appendix 9, Box 5.3, page 105.

Therefore, Ofwat would expect to engage with detail on the capability and cost of smart metering systems, as well as evidence on the benefits that water companies expect. Indeed, Ofwat's responses to metering proposals in companies' draft WRMP24 show that Ofwat:[19]

- Places equal weight on cost and benefits of metering solutions;
- Challenges proposals that seek cheaper metering solution with low or no smart capability – i.e. Ofwat is looking for evidence of cost-effective delivery of benefits, rather than necessarily the lowest cost solutions;
- Seeks evidence of the interaction between metering solutions and companies' ability to meet a supply-demand balance and long term strategic outcomes;
- Considers the timeline for companies' proposed rollout and puts the onus on companies to demonstrate that the proposed timelines offer ambition, deliverability and cost effectiveness; and
- Is drawing comparisons between companies' proposals and PR19 metering allowance, including on the basis of unit costs (e.g. meter installation unit costs and implied water saving costs (£m/Ml/d)).

Overall, Ofwat is looking for well-developed options with fully articulated links to the companies' long term objectives. Ofwat is also looking for a clear breakdown of costs, benefits and evidence behind assumptions, including water savings. This includes cases where business cases propose AMI solutions, including where companies state that the additional costs, over AMR, are minimal.[20]

Implications for Ofwat assessment of smart meter business cases

Based on the above, we consider that Ofwat would expect to see detailed cost breakdowns of costs over time, and evidence of efficient procurement.[21] In PR19, Ofwat analysed business cases for smart meter solutions and considered benchmarking between companies, to arrive at the smart meter allowance uplift at Final Determination stage.[22] Ofwat appears to be employing similar techniques in responding to companies' draft WRMP24 papers.

The framework that we identified for considering smart metering costs and benefits in Figure 2 has two related implications for Ofwat's assessment of smart metering programmes:

- Some of the costs will be significantly more challenging to benchmark; and

19 Published here https://www.ofwat.gov.uk/regulated-companies/resilience-in-the-round/water-resource-planning/ofwats-engagement-on-wrmp24/ofwats-feedback-on-draft-wrmp24-and-draft-regional-plans/.

20 See for example Ofwat response to South Staffs Water draft WRMP24, page 6.

21 Ofwat has proposed benchmarking in a smart meter context. In its PR19 Final determinations, Ofwat also engaged in "benchmarking of activities between companies where possible" in the context of assessing costs specific to smart metering proposals (see Ofwat, PR19 Final determinations: Securing cost efficiency technical appendix, page 84).

22 Ofwat, PR19 Final determinations: Securing cost efficiency technical appendix, page 84.

- The difference in benefits and associated costs of different technology solutions, means that the costs and benefits need to be evaluated in an integrated way and not assessed separately.

With relation to the first issue, some the activities associated with a smart meter programme should be more readily identifiable and feasible to benchmark. These would include the construction of meter boundary boxes and the installation of meter devices. However, at the opposite end of the spectrum, the costs of: the communications infrastructure; the data management processes and investment in integrating the use of high frequency data into wider business processes, would be considerably more difficult to benchmark. One option would be for Ofwat to measure performance on cost per read, alongside data on cost per meter. This would help to reflect the benefits from high frequency, and reliable, data capture as outlined above.

More sophisticated data deployment will have additional staff and system costs and depending on the level of ambition, may require considerable investment in order to integrate into the core of the business. In particular, some companies with high ambition may expect that integrating data solutions into the core business would drive second order effects, such as improved network management and investment decisions. While these could be integral to the company's longer term, quantifying and benchmarking these costs and benefits would be particularly challenging.

This is closely related to the second issue outlined above. The implication of the framework in Figure 1, is that as the benefits of higher functioning AMI solutions cannot be achieved at the cost of lower functioning solutions. Therefore, combining cost estimates from both types of systems in benchmarking, would lead to an inefficient calculation of allowed revenues.

We consider a simple hypothetical example, where Ofwat were to, separately, take an upper quartile estimate of costs and an upper quartile estimate benefits. Combining these, in setting an efficient cost and performance level, would result in a solution that was not feasible to deliver.

More generally, if Ofwat were to set a benchmark cost allowance that is too low, companies may reduce the scope of AMI solutions, by for example reducing data capability or property coverage. As we discussed in Section 4, this could reduce the benefits from smart metering significantly and affect the potential for smart water metering to contribute to companies meeting their delivery ambitions.

Given the importance of funding the right solutions at this stage, this issue has the potential to determine the extent, to which companies are able to be ambitious and innovative in fulfilling Ofwat's direction for smart metering. Ofwat could ensure that companies are clear about the level of performance they are expecting from the smart water metering systems they are deploying and when they think that level of performance will be delivered.

In Section 2 we also highlighted the vital contribution that smart metering data will play in Ofwat's aspirations for the water efficiency fund, as well as broader benefits such as supporting vulnerable customers. Understanding the level of performance that companies are expecting from their smart metering plans will be important for Ofwat to be confident that their objectives in these areas can be met.

Implications for water companies

The findings above indicate that water companies have key decisions to make, in relation to the technological solution and ambition that they wish to deploy.

First, in terms of the technology solutions. Companies may be considering solutions with lower functionality or an unproven track record, but with costs lower than those of alternatives. In appraising these decisions companies should take account of the time-frame of the decision (i.e. the technological lock-in).

Using the adaptive planning framework companies should consider:

- Whether the technology solution being developed can deliver the benefits required from smart metering over the next 15 to 20 years?
- Does the solution deliver the optionality to meet more extreme scenarios?

Second, the size of the required investment means that companies may seek to 'phase-in' their smart metering programmes over time, and across locations.

In evaluating options to 'phase-in' the smart metering programme, companies should consider the following:

- The technical capability and managerial transformation that would be required, to adopt high capability smart metering data solutions at the core of the business, are substantial. As with any new technology and deployment of large-scale data, there is also uncertainty around precisely how the use of data in the sector can be optimised and linked to improvements in physical network management and resources savings. A phased roll-out may provide more time for the company to develop the internal capability to handle large volumes of data and deliver the benefits to customers. However, companies need to consider, whether this would deliver benefits in a timely way to meet the challenges faced and whether it provides the optionality, to meet more extreme scenarios.
- Under a phased roll-out there may be greater risk that customers do not perceive the smart meter benefits or experience reliability issues. Customer disengagement and reductions in the granularity and timeliness of a systems' data capability, therefore carry risks for a smart programme's ability to contribute to delivery ambitions

Specifically, we note that some companies plan to commission AMR technologies, according to their Draft Water Resource Management Plans, potentially prior to upgrading to AMI in the

future,[23] which Ofwat singled out as requiring further evidence that this will be cost-effective in the long run.[24] This is an important consideration as the evidence above does not indicate that AMR solutions can be directly scaled up to perform with the capability of AMI. While some components may be common to both (e.g. physical meters and some ground infrastructure), AMI solutions are considerably more sophisticated. There may therefore be a degree of obsolescence or incompatibility between the systems, meaning that installing an AMR solution first, may lead to duplication of costs in the long-run.

Given the early stages of deployment of smart water metering and the increasing challenge that water companies will face in meeting the ambitions that have been set out, there is merit in considering these issues, in the context of Ofwat's adaptive planning framework.

As outlined in Section 4, companies should address the following questions:

- Does a 'low functionality' solution meet the needs of the company under the core scenario for the entire life of the investment?
- Does a 'low functionality' solution meet the needs of the company under all plausible scenarios?
- Would a 'low functionality' solution engage individual customers and offer them a good customer experience?
  - Would the customer experience promote engagement with the company's smart metering and resource savings programmes?
  - Will the solution meet current and future regulatory expectations for customer engagement on water efficiency and also support for vulnerable customers?
- If the 'low functionality' solution does not satisfy these tests:
  - What additional costs would be incurred to upgrade the functionality of the existing solution before the end of its planned asset life (i.e. the costs of stranded assets)?
  - How does this compare to the additional costs of a 'higher functionality' initial solution?
- What additional optional benefits would a 'higher functionality' solution deliver to allow a company to be resilient in the face of more extreme scenarios?

These are fundamental considerations for companies, against the backdrop of the ambitious and challenging delivery requirements for the sector.

[23] See Welsh Water Revised draft water resources management plan 2024, page 83.

[24] Ofwat, Welsh Water – draft water resources management plan 2024 consultation response, 23 February 2023, page 7.

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