Flow Measurement
Special Interest Group

Water Industry Flow Metrology Horizon Scan

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Executive Summary

This report focuses on the potential flow measurement requirements within the UK's domestic water industry for consideration as part of the UK National Measurement System's Research and Development programme as well as supporting wider academic research. Insights were gathered from stakeholders within the water industry through meetings, telephone calls, desk studies, email correspondence and attendance at various conferences and networking events.

The review was undertaken under the auspices of the Institute of Measurement and Control (InstMC) Flow Measurement Special Interest Group and was part funded by the Department for Business, Energy and Industrial Strategy (BEIS).

Details of the insights that have influenced the key findings and recommendations contained within this report can be found in Section 5 and are summarised as follows:

- There exists no evidence of foreseeable demand for more accurate flow meters.
- There is a requirement for the improvement in measurement of total system performance within the water industry.
- There is a need for improved test facility infrastructure to enable research that will give better understanding of large flow meter (1000 mm diameter) verification and uncertainty values.
- The UK should develop a knowledge transfer strategy to leverage the work completed on Big Data in other industries to help support the water industry.
- The work developed in the Euramet MetroWaMet project should be disseminated across the UK water industry to enable adoption of its recommendations.
- Further analysis is required to consider the flow metering requirements for water applications in other industries.
- The four Centres of Excellence identified should consider the development of an R&D network designed to exploit their capabilities to help address both current and future challenges.

Delivering advances in the priorities and challenges mentioned above will impact positively upon the UK water industry and provide an improved metrology foundation on which to measure the industry's achievements against it key challenges.

CONTENTS

ABBREVIATIONS

AMP	Asset Management Plan Period
AV	Area Velocity Meter
BEIS	Department for Business, Energy and Industrial Strategy
CCC	Climate Change Committee
EA	Environmental Agency
JIP	Joint Industry Project
InstMC	Institute of Measurement and Control
NMS	National Measurement System
Ofwat	Water Services Regulation Authority
PAS	Publicly Available Specification
R & D	Research and Development
STW	Severn Trent Water PLC
WI	Water Industry
WRc	Water Research Centre

1. Scope and Objectives

This report has been produced as part of a requirement to produce a series of industry-focused documents that articulate the flow measurement challenges on a 10-year time horizon to support research and co-funding priorities. This report focuses on the priorities for the UK domestic water industry.

2. Background

2.1. Water Industry

The UK water industry has physical assets in England and Wales comprising more than 1,000 reservoirs, over 2,500 water treatment works and 9,000 sewage treatment works. There are more than 900,000 kilometres of mains and sewers buried underground **[1]**. In addition, there are around 1,837 wastewater treatment works, 50,000 km of sewer pipes and 47,000 km of water pipes in Scotland **[2]**.

The water industry in the UK comprises a directly employed population of 130,000 and an indirect population (through sub-contracts, ancillary activity and product delivery) of a further 86,200 **[3].** It has an annual turnover of more than £12bn and 65 million consumers reliant upon its products.

According to the Committee on Climate change **[4]**, population growth and climate change mean that the water industry faces growing pressure to address challenges such as water scarcity (with drivers to reduce water abstraction volumes by 50 % over the next 20 – 30 years) **[5]**, environmental quality and improving the resilience of systems and services to customers. Abstraction refers to the process of removing or extracting water from a natural source such as an aquifer, river, lake etc., the water can be used for a variety of uses ranging from irrigation to drinking water.

Annex 6 provides a list of Environmental Agency (EA) websites for information on abstraction limits. This all takes place in a world of rising customer expectations around quality of service and accountability and brings new opportunities to deliver services.

During the investigations undertaken for this review, several UK Centres of Excellence were identified:

- WRc in Swindon **[6]**: has multiple facilities ranging from open channel flumes to a pipe-line capable of testing flow meters with flow rates up to 120 l/s. They also have a test pit that is capable of testing submerged pipe, to simulate buried pipes, whilst applying differing mechanical loads onto the surface.

- HR Wallingford in Wallingford **[7]**: has large open channel flumes capable of generating flows over 2 m/s in a 75 m long channel. It also has Tsunami test facilities and can test flood protection devices.

- ARK, University of Hull **[8]**: is the national flood resilience centre with a flood test facility in which full-scale urban and rural environments can be flooded to provide emergency responders with realistic water training and the research community with large-scale research and innovation test facilities.

- TÜV SÜD National Engineering Laboratory in East Kilbride: holds the UK's National Standards for flow and density measurement.

These four Centres of Excellence should consider the development of an R&D network designed to exploit their capabilities to help address both current and future challenges.

3. Methodology

To assess the need for new capability, the views of multiple stakeholders within the water industry were solicited. This was achieved through meetings, telephone calls, desk studies, email correspondence and attendance at various conferences and networking events. Annex 1 outlines the principal topics raised during these communications, which aimed to identify future requirements for new flow measurement capability and research and development (R&D) within the UK's domestic water industry. Annex 2 identifies the people contacted during this review.

4. Findings

4.1. Metering Performance and Uncertainty

This review found no evidence of foreseeable demand, for at least the next Asset Management Plan Period (AMP) 5-year period, for more accurate flow meters, implying there is no need for new capability to support such metering technologies.

The priorities for the domestic water industry have been identified as:

- an improvement in measurement of total system performance
- a better understanding of meter uncertainties.

And relate back to two of the industry's major challenges, namely:

- expectation that water abstraction volumes will be reduced by 50 % by 2050
- reduction of leakage by 15 % over the next 5 years.

In order to estimate leakage levels within the network, water companies must undertake a water mass balance on their networks. Their conclusion is based on the metering knowledge available to them. Typically, mass balance is used to determine whether there is missing water within the system, which is quoted as leakage. By examining the uncertainty or an estimate of the expected uncertainty of the various meters used in the water mass balance, it is possible to determine if the missing water is actually due to leakage or meter uncertainty.

One water company **[9]** reported that they have five flow meters with diameters greater than 1000 mm, measuring approximately 25 % of the flow through their entire network. Consequently, a relatively small error in the uncertainty values of one of these meters could create large volumes of missing water that could be misrepresented as leakage. As this situation is likely to be replicated amongst the other domestic water companies, it is clear that improved knowledge of meter uncertainty and validation could deliver significant impact.

In order to achieve this, it is recommended that a Publicly Available Specification (PAS) be developed, covering the Audit of Water Flow Meter Systems. A PAS is a consultation document based on the British Standard model and used to document standardised best practice on specific subjects.

Key Findings:

- No evidence of foreseeable demand for more accurate flow meters
- A need for improvement in measurement of total system performance
- A requirement for better understanding of meter uncertainties.

4.2. Large Diameter Test Facility

Several industry experts **[10, 11]** raised the need for a facility for testing flow meters of 1000 mm diameter or greater.

One UK water company has around 500 million litres/day water entering the supply through pipes of 1000 mm (40 ”) or greater in diameter. Some testing has been undertaken overseas in the USA and Brazil **[11, 12]**, but these tests were not conducted on a flow facility. Whilst this previous work is helpful **[11, 12]**, it lacks the necessary accuracy for reliable flow measurement.

Previous work **[13]** suggests that large pipe diameters result in large errors. The water industry is trying to half abstraction by 2050 **[7]** and aspires to eliminate leakage by 2050 **[5]**. In order to achieve this, accurate knowledge of the meter uncertainties used in the network is required. Hence, the need to undertake research on large diameter meters (> 500 mm). Moreover, configurations differ significantly in the field and the effects of this additional complexity are not understood. There are limits to what can be inferred through modelling and simulation, therefore, this can only be addressed through the creation of a facility that can test flow meters and pipe/valve arrays up to 1000 mm diameter.

Some test facilities in the UK are capable of operating with flow meters exhibiting diameters of 1000 mm or more **[14, 15]**. However, these are owned by meter manufacturers and may not be seen widely as truly independent. Such test facilities are limited to calibrating flow meters with straight sections of pipe upstream and downstream of the meter under test. There also exist large test facilities in Europe, but these are, again, owned and operated by meter manufacturers. Experts advise that testing complex hydrodynamics within an independent test facility is essential as these can exert a major detrimental effect on meter performance. This suggests a need for 90-degree bends, valves etc. to replicate real-world conditions. Therefore, testing flow meters under harsh, rather than ideal, hydrodynamic conditions in an independent test facility would be advantageous.

To determine if this requirement is industry-wide, seven of the twelve major water companies in the UK were contacted. Two responded in support of the creation of a Large Diameter Test Facility, with both offering to collaborate in its design. However, whilst each would make use of it once operational, neither would be willing to pay exclusively for such a facility. Such a response is considered to be representative of the wider water industry.

The significant cost of such a test facility is clearly prohibitive to any water company being in a position to finance its construction alone and falls squarely within the definition of a facility that cannot be constructed because of a market failure.

Key Finding:

- There is industry appetite for a dedicated facility to undertake research on very large flow meters, which could be achieved through a collaborative funding mechanism.

4.3. Big Data/Real Time Metering

Feedback from a major company **[9]**, revealed that, in order to meet future requirements, they will have to move to almost complete coverage of all revenue flow meters by 2035. Together with a move to complete meter coverage, there will also be a move to SMART meters and complete autonomous networks based on these. To achieve both will require real-time monitoring of the data generated by the meters, together with the exploitation of 'Big Data' and data handling to manage operations and assets.

Integration of flow measurement information was seen universally by those consulted for this review as a pre-requisite to produce information essential to timely decision-making on the wider scale. This would inform and facilitate optimisation of resource utilisation in the overall water cycle. Exaggerated environmental events, which climate change modelling has predicted, bring new demands. They require enhanced short-term timescales (minute by minute), as well as significantly improved longer term (annual) decision-making capabilities. These requirements cannot be met without appropriate metering infrastructure.

Networks, and their control, now dominate the supply and removal of water/wastewater within modern populations. Experts predict that near future enhanced electronic data communications, such as local and wide area electronic networks, will be capable of transforming water/wastewater network control. In particular, there is an expectation of data equivalence arising from different sources and of interoperability through electronic network infrastructure. A presentation given at a recent conference suggested that the water industry needs to follow the same approach to SMART metering as the energy industry has done in recent years **[16]**. However, this is only likely to happen if the UK Government, regulator(s) and water companies work together to develop a standard system **[17]**.

To facilitate this work will require a combination of knowledge obtained from flow metrology and in-situ meter verification. This is currently being developed in the oil and gas industry and is transferrable to the water industry. It will provide a tool for the water industry to help achieve the challenges it has identified (i.e. leakage and abstraction reduction).

Key Finding:

- The UK should develop a knowledge transfer strategy to leverage the work completed on Big Data in other industries to help support the water industry.

4.4. Area Velocity Metering

Historically the period since the mid 1980's has seen both an increase in the absolute number and geographic disposition of meters deployed within the clean water network of all UK water companies; a similar trend is now underway in relation to dirty water sewer and industrial waste metering networks. The driver is Climate

Change, the effects of which are to create increasingly large and sustained surge events, in turn potentially compromising the integrity and containment of the (ageing) historic infrastructure.

An issue associated with open channel flow measurement is the method by which the AV meters derive the liquid flow rates. This is achieved by measuring the water depth and the flow speed at a limited number of points. These calculations assume a particular flow profile within the channel, which then allows the average speed to be derived from the point measurements. If there is turbulence or disturbances in the flow profile, then it is possible the point measurements could miss the main flow, or the profile may be different creating a measurement error. These disturbances can be caused by debris on the base of the channel or deterioration of the channel walls/base.

Climate change will increasingly deliver rainfall in shorter heavier events, which will lead to significant problems in flow management within the existing sewer and open channel watercourse infrastructure e.g. probable widespread foul water flooding, general “out of bank” events, and unmeasured discharges into sensitive waterways. Such events will lead to property, structural and environmental damage; some short-term, many long-term. Therefore, more accurate measurement helps predict and prevent flood events which in turn protects structure, environment etc. It has been estimated **[18]**, that the winter floods of 2015/2016, cost the UK economy £1.6bn in economic damage, a breakdown of this total cost is given in **[18]** but it has been estimated that £350m can be attributed to residential properties, £510m for business and approximately £341m for transport (Road/Rail).

Additionally, the surcharging of sewer structures during storm events is becoming more frequent, rather than the exception as has been the case. This is accentuating the drive to non-contact instrumentation or to instrumentation which is capable of operating in both free air and drowned environments.

There are two Centres of Excellence capable of undertaking such work. They are WRc Laboratories in Swindon and HR Wallingford in Wallingford, with both having open-channel flow facilities.

Key Finding:

- Research needs to be undertaken to investigate the effect of any deterioration of the channel profile or debris on the channel base on the uncertainty of any flow measurements made.

4.5. MetroWaMet Project

A Euramet project entitled MetroWaMet **[19]** is currently underway. This aims to characterise domestic water meters under real-world conditions.

MetroWaMet will:

- Investigate domestic consumption patterns, in particular the transient aspects associated with washing machine/dishwasher filling.
- Decide upon a representative test sequence of these rapidly changing flows.
- Test a range of meter types with this test sequence to assess their accuracy.
- Test meters with different water qualities to see if this has an impact.
- Report on these effects.

Some members of the TC30/SC7 BSI committee have indicated their willingness to share with MetroWaMet the large quantity of high frequency domestic consumption data they hold, which will facilitate progression of the project.

Another objective of the MetroWaMet project is to examine how domestic meters with no moving parts (e.g. ultrasonic or electromagnetic meters) degrade with time in the real world. There is a durability test in the relevant standard, but this is aimed primarily at the durability of bearings, maintenance of clearances, etc., in mechanical meters. It does not cover the degradation of, for example, the mirrors in ultrasonic meters or how the meter's algorithm deals with this. For example, by lowering the acceptance threshold and thereby including more noise into the signal and what effect this has on metering/billing accuracy.

Therefore, it will be important that the results emanating from MetroWaMet are monitored closely and disseminated widely as these have the potential to support a move to total revenue meter coverage in the UK.

Key Finding:

- There is a need for knowledge transfer activity to disseminate the recommendations arising from the MetroWaMet project to ensure their integration into the UK water industry, such that the UK Water Industry remains at the forefront of new developments in flow metering.

5. Recommendations

The rationale for these recommendations is set out in the Findings Section (4.1 to 4.5).

Recommendation 1: The four Centres of Excellence (Wrc, HR Wallingford, ARK Hull and the TÜV SÜD National Engineering Laboratory) should consider brigading some of their capability to help address both current and future challenges.

Recommendation 2: The UK should develop a Publicly Available Specification (PAS) to provide a standard best practice guideline for large meter verification, including standard approaches for large meter uncertainty determination.

Recommendation 3: The UK should consider development of a Large Diameter Water Meter Test Facility and Standard**.**

Recommendation 4: The UK should combine the knowledge gained from the oil and gas industry on in situ meter verification and Big Data and transfer it to its domestic water industry through a Best Practice Guide.

Recommendation 5: Research needs to be undertaken to investigate the effect of any deterioration of the channel profile or debris on the channel base on the uncertainty of any flow measurements made.

Recommendation 6: There is a need for knowledge transfer activity to disseminate the recommendations arising from the MetroWaMet project to ensure their integration into the UK water industry.

Recommendation 7: A further report detailing the flow metering requirements for other water applications should be undertaken.

6. References

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2. https://en.wikipedia.org/wiki/Water_supply_and_sanitation_in_Scotland
3. https://www.euskills.co.uk/about/our-industries/water/
4. The Committee on Climate Change (CCC): various key reports including:
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   ii) UK Climate Change Risk Assessment 2017: https://www.theccc.org.uk/publication/uk-climate-change-risk-assessment-2017/
   iii) 2017 Report to Parliament – Progress in preparing for climate change: https://www.theccc.org.uk/publication/2017-report-to-parliament-progress-in-preparing-for-climate-change/
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   v) Updated Indicators of climate change risk and adaption action in England (ADAS): https://www.theccc.org.uk/publication/updated-indicators-of-climate-change-risk-and-adaptation-action-in-england-adas/
   vi) Net Zero – The UK's contribution to stopping global warming: https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/
   vii) Net Zero – Technical Report: ccc.org.uk/publication/net-zero-technical-report/
   viii) Progress in preparing for climate change – 2019 Progress report to Parliament: https://www.theccc.org.uk/publication/progress-in-preparing-for-climate-change-2019-progress-report-to-parliament/
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13. Water Into Supply – What Uncertainty Should We Expect, Global Leakage Summit, London, 2018
14. Flow Calibration, ABB Facilities Overview, ABB Stonehouse: https://cdn.krohne.com/dlc/BR_CALIBRATION_en_180111.pdf
15. Calibration Technical Fundamentals, Krone Calibration Test Facility: https://cdn.krohne.com/dlc/BR_CALIBRATION_en_180111.pdf

16. FWA Water Networks, Alternative Thinking for Alternative Strategies, 7th November 2019, Leamington Spa, 'Powering the need for transformation to a smart energy market and beyond' Fabienne Dischamps
17. FWA Water Networks, Alternative Thinking for Alternative Strategies, 7th November 2019, Leamington Spa, 'Alternative thinking for alternative strategies' James Hargarve
18. 'Estimating the Economic Costs of the 2015 to 2016 Winter Floods', January 2018, Environment Agency
19. Euramet Project, MetroWaMet: https://www.euramet.org/research-innovation/search-research-projects/details/?tx_eurametctcp_project[project]=1540&tx_eurametctcp_project[controller]=Project&tx_eurametctcp_project[action]=show
20. "The Strategic Review of Charges 2015 – 21 – Final Determination" Water Industry Commission for Scotland, https://www.watercommission.co.uk/UserFiles/Documents/Final%20Determination%20-%20Final.pdf

Annex 1. List of Topics Referenced During the Horizon Scanning Exercise

The list below gives the general topics under which questions were asked of the various stakeholders within the water industry.

1 Climate change resilience management
Leadership across different sectors
UK Big Picture view

2 Device powering options
Limitations of devices & IoT

3 Ascribing value to water
Determining priorities for water allocation
Water politics
Management of information

4 Open Sourcing data
Increasing Regulatory influence

5 Modelling in real time
Optimising resource utilisation

6 Communications technology for devices
Integration into data networks
Meter aggregation

7 Data analysis methods
Application of new mathematics
Acquiring different data

8 Networks
Acquiring more data
Acquiring time relevant data

9 Front end signal processing
Incorporation of computing power

10 Primary measurement techniques/discovery
Front end instrumentation
Development of existing measurement techniques

Annex 2. Contact List of People Contacted During Investigation

Contact Name	Position	Company
Andrew Goodley	Senior Consultant Flow Measurement & Metering	WRc, Swindon
Ian Holmes-Higgin	Global Portfolio Leader – residential Water Meters	Honeywell (Kent Meters)
Steve Dixon	Physics Professor; Director Centre for Industrial Ultrasonics	Warwick University
Simon Draper	Head, Design & Development Water Metering	ABB
Graeme Cross	UK Manager	Vega Controls
Ray Keech	D & D Engineer	ABB
Laurent Solliec	R & D Leader	Nivs
Ian Parrott	Director	Aqula
Andrew Chappell	Technical Advisor	EA
Mikal Willmott	Leakage Assurance Analyst	ST Water
Andy Hammond	UK Manager	Flexim
Purvang Upadhyay	General Manager M + A	ABB
Alex Buddrick	Project Manager	Flexim
Luke Stanbridge	Verification Team	Z-Tech
Gary Stockdale	STW Innovation Team	ST Water
Tim Door	Europe & RSA Manager	McCrometer
Rhys Durham	Verification + Uncertainty Project	WRc, Swindon
Stavros Karachountris	Thames Water Smart Metering Manager	Thames Water
Bradley Morris	Network Asset Maintenance Manager	Thames Water
Andy Hudson	WI Accounts Manager	E & H
David Andrews	Engineer	Vega
Derek Buckland	Engineering	Technolog
Richard Bragg	Principal Engineer, OT	United Utilities
Alicja Solarczyk	Project Engineer	United Utilities
Steve Quarmby	Capital Project manager, Innovation	United Utilities
Daniel O'Connor	Senior Engineer, OT	United Utilities
Michael Gallagher	Principal Engineer (Hydraulics), Engineering	United Utilities
Richard Brindle	Head of Bio Resources Strategy, Asset Management	United Utilities
Tony Griffiths	Wastewater Network Strategy Manager, Asset Management	United Utilities
Adam Lechmere	Water Network Technical Specialist, Asset Management	United Utilities
Rosa Richards	Programme Manager	SWIG
Danny Ronson	Engineering – Meter Verification Technology	Siemens
Oliver Grievson	Technical Lead	Z-Tech
Tim Brus	Water Balance Planner	Scottish Water
James Howard	Leakage Optimisation Manager	DWR Cymru
Prof. Daniel Parsons	Professor of sedimentology	University of Hull

Annex 3. Databases Reviewed

- Grants on the Web (RCUK Databases)
- Gateway to Research (RCs and Innovate UK)
- Individual research council databases (EPSRC, NERC, BBSRC)
- EU-Cordis (Euramet)
- ESA

Annex 4. Introduction to the Water Industry

The UK'S water industry provides drinking water and wastewater services (including sewage treatment) to residential, commercial and industrial sectors of the economy. Typically, public utilities operate water supply networks. The key industry priorities identified through this horizon scan include:

1. **Securing long term resilience** – The water industry needs to invest several millions per day over the next five years, over and above investment to maintain existing assets. For a sector with such a large and old asset base (900,000km of sewer and water supply pipes, with an estimated age of 70 years), this is a significant challenge.
2. **Great customer service** – Ofwat/WICS is calling on the water industry to reduce customer bills by circa 12.7%. In addition, all types of customer should receive uninterrupted water services by minimising disruptive events such as drought, flooding, leakage, infrastructure and operational issues. Together with this, water companies also have to reduce water poverty by ensuring almost 1.5million customers obtain help with their water bills.
3. **Innovation** - It is impossible for the sector to deliver much more for less without significant innovation. Like many other sectors, the water industry looks towards industry and supply chain to resolve current and future challenges. With regards to innovation, individual water company best practice has changed with greater emergence of innovation schemes. The advent of these innovation schemes and regional competitions, has revolutionised the major UK water companies' approaches to strategic and operational problems. This includes flow and has dramatically improved company-to-industry liaison, most especially with SME's.
4. **Alignment with other UK Government priorities** – Alignment with priorities such as the Industrial Strategy and climate control are highly prevalent. Climate change drivers are set to emphasise the importance of the overall water cycle management in the UK. As quantities of water abstracted are reduced (drive towards 50% reduction in abstraction volumes over the next 20 – 30 years), coupled with the probability of significant and more frequent flooding events, the requirement to measure and analyse the flow of water across the entire water cycle will become a necessity in order to be able to implement and run efficient resource management, both at the individual water company and national level.

Noticeable in several discussions were comments concerning the gap which companies perceive has developed between the required pace and the generic scope of water industry regulation. The 5-year Asset Management Plan (AMP) was cited repeatedly as severely constraining development and investment in innovation and working against rapid implementation of new measurement and communication technologies. Figure A4.1 illustrates Ofwat's summary view of current industry performance statistics.

To determine the price that privatised companies can charge for water, the regulator Ofwat, undertakes a price review every 5 years. AMP6, which ran from 1st April 2015 to 31st March 2020, will shortly come to an end. AMP6 concentrated on cutting OPEX and moving from CAPEX to TOTEX and building upgrades to infrastructure that would last longer and cost less to run. AMP7 is due to commence on 1st April 2020 and is set to concentrate on the environment.

Scottish Water also have a regulator, Water Industry Commission for Scotland (WICS), who also regulate the amount of money that Scottish Water can charge for their product. WICS use a six-year period as opposed to Ofwat's 5-year period and the current review period has been running since 2015 and will run to 2021 **[20]**. WICS also set targets for Scottish Water encouraging Scottish water to reduce leakage levels, as well as giving performance measurement on the customer experience with Scottish Water.

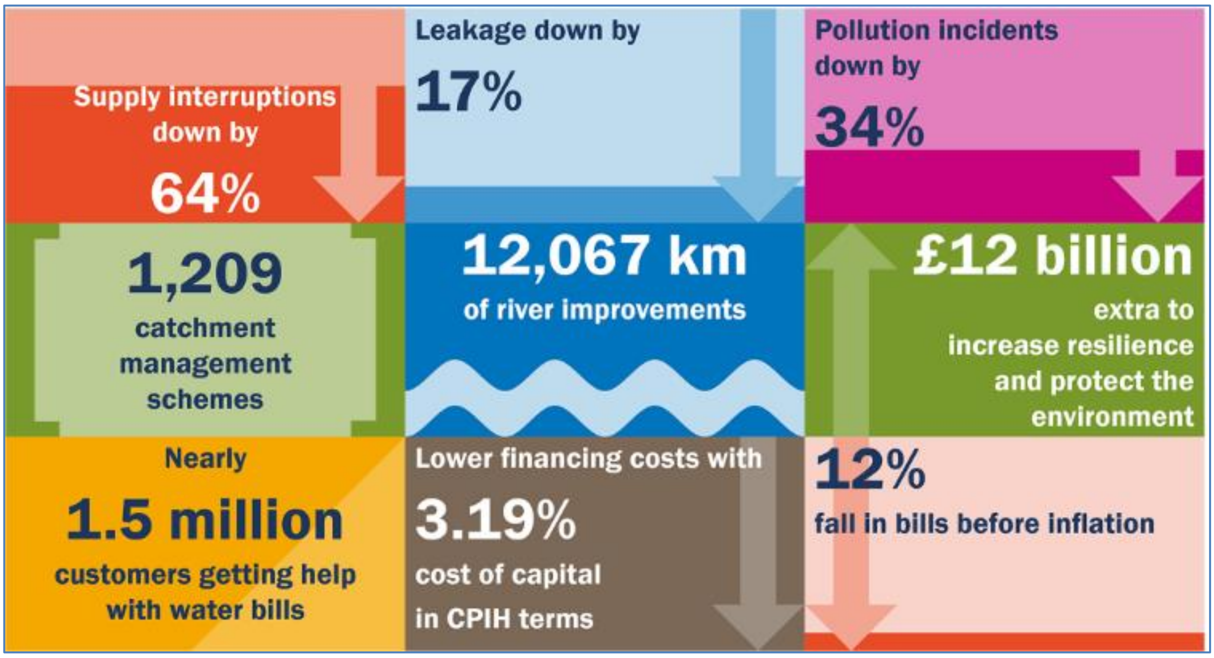

Figure A41: OFWAT's View of Industry Performance Statistics

Downloaded from the following link: https://www.ofwat.gov.uk/regulated-companies/price-review/2019-price-review/draft-determinations/#late

Annex 5. Water Industry Case Study – Severn Trent Water

The UK water industry has been active in addressing many current challenges through increased use of Innovation teams. One PLC, Severn Trent Water (STW), was willing to disclose its 2018 Innovation Needs, outlined in Figure A5.1.

Within this document, climate change is inherently acknowledged and the need to drive towards a carbon neutral business in an increasingly carbon neutral world is unequivocally stated. Both drivers call for improved flow measurement across their business.

The thrust of STW's *Our Innovation Needs* statement can be summarised as follows:

1. A real term reduction in leakage: Target 15 % between 2018 and 2023, i.e. a 3 % reduction per year for the next 5 years

2. Finding ways to reduce Total Abstracted Water Volume: target reduction 50 % in ten years

3. Creation of a carbon neutral water business including extracting all value from waste e.g. extensive use of digestors; on-site electricity generation etc.

4. Reducing service failures by 30 %+ and implementing SMART diagnostics, reference regulated bacterial and water discolouration events

5. Finding solutions to the removal of 'emerging contaminants'
6. Using AI and Robotics; target to automate 30% of production and support services activities.

This ambitious, focused needs document, from the second largest privatised UK water company, stands as corroboration of several of the Horizon Scanning findings and can reasonably be viewed as representative of the future direction of the industry as a whole.

From discussions with one leading water industry representative **[5]**, water company expectations are that by 2050, the legally enforced licensed abstraction volumes set by the EA in individual operating areas are set to fall by around 50 % and this severe generic reduction will be applicable nationally, i.e. the predicted 50 % lowered abstraction in its area will spread across the board nationally.

Most significantly, the representative interviewed stated that they plan to achieve this 50 % reduction in water resources within 10 years, over 20 years earlier than the 2050 target. A remarkable ambition for which it will need to engage with a wide variety of partners in order to deliver the result.

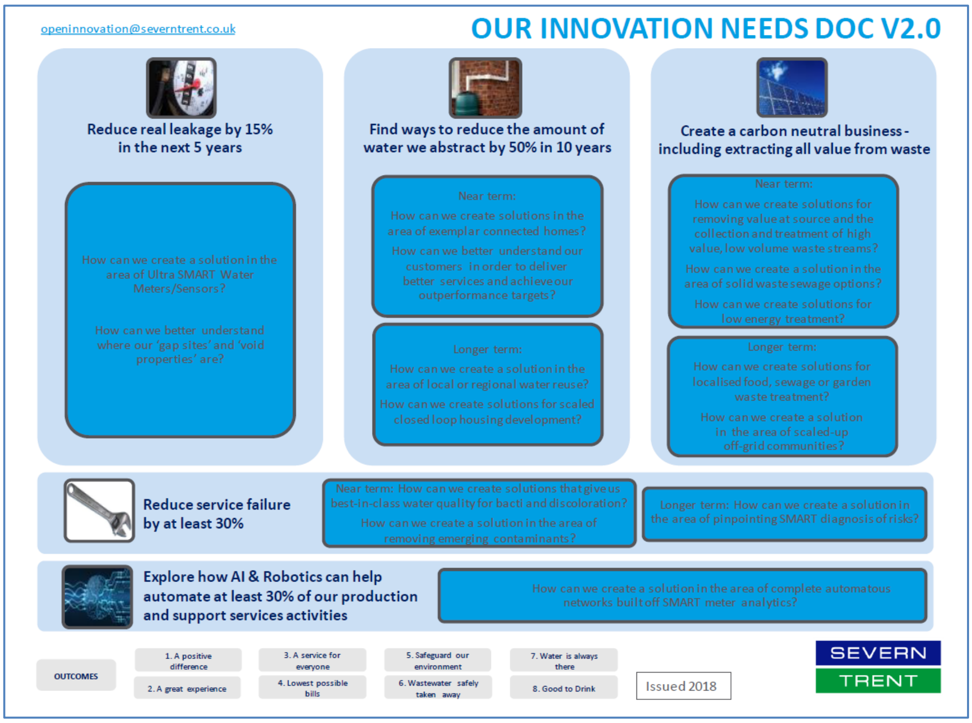

Figure A5.1: Severn Trent Water Ltd; Statement of Innovation Needs (2018)

Annex 6. Environment Agency/UKIA Water Licence & Abstraction Links

Guidance – How to make sure your meter is accurate: https://www.gov.uk/guidance/water-abstraction-how-to-make-sure-your-meter-is-accurate

Guidance – Measure, record and report your water abstraction: https://www.gov.uk/guidance/measure-record-and-report-your-water-abstraction

Abstraction Metering Good Practice Manual; EA R&D Technical Report W84; Research Contractor WRc Plc; @Environment Agency 2009: http://adlib.everysite.co.uk/resources/000/262/557/Abstraction_Metering.pdf

UK Irrigation Association: http://www.ukia.org/

The UK Irrigation Association offers comprehensive advice on this area. In 2019, it published "The Irrigators' Handbook". Contact Melvyn Kay secretary. Office Ruth Gage: r.gage@UKIA.org