

Innovation priorities for the water sector

Water Sector Innovation Leadership Group
May 2011



About this document

This document highlights areas of water and wastewater delivery where innovation should be a priority. It is intended to encourage individuals and organisations to develop innovative solutions in these areas.

These priority areas have been identified by the Water Sector Innovation Leadership Group. This is a group of key stakeholders who provide leadership and direction to innovation within the water sector.

The term 'water sector' refers to all individuals and organisations contributing to the management of water and wastewater in the natural environment.

It includes, but is not restricted to:

- government departments;
- regulators;
- water and sewerage companies;
- local authorities and development agencies;
- consumer representative organisations;
- consultants, contractors and supply chain companies;
- universities, research centres and research councils; and
- trade bodies.

The views expressed in this document are the collective views of the Water Sector Innovation Leadership Group. They do not necessarily represent the views of individual members.

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1. Introduction

1.1 What is innovation?

Innovation is the application of new technology, business processes or management expertise that delivers any improvements to customer service, the environment or cost efficiency.

Delivering these improvements will not only benefit the water sector, they will also contribute to the UK economy. This is why innovation should be encouraged.

1.2 Why do we need more innovation?

As water and wastewater services have developed over time, innovation has delivered significant improvements to customer service, the environment and financing.

However, new challenges now threaten the sustainability of these critical services over the long term. They include:

- a changing and unpredictable climate and the need for adaptation to reduce risk and increase resilience;
- population growth, particularly in south-east England where water is already scarce;
- economic uncertainty and affordability issues;
- rising environmental standards, including implementing the EU Water Framework Directive; and
- changing energy demands and the need to reduce greenhouse gas emissions.

If the water sector is to overcome these challenges successfully, it will need to significantly increase the amount, and rate, that it innovates.

1.2 What is the Water Sector Innovation Leadership Group?

Innovation can be delivered by any individual or organisation. The areas where they will try to innovate will depend on various factors. And the pace at which innovation is delivered will also vary.

Because of the amount and pace of innovation required, there is a need for the water sector to prioritise and focus efforts to innovate.

The Water Sector Innovation Leadership Group was established by the Department for Environment, Food and Rural Affairs (Defra) to provide the focus and leadership required to co-ordinate the approach to innovation across the water sector. Ofwat is a member of the group and also provides the secretariat.

The group consists of several key stakeholders from across the water sector.

Our objectives are to:

- encourage the sector to value and promote innovation;
- develop cross-sector solutions and partnerships to solve common challenges;
- create an environment that stimulates innovation, growth and business development across the sectors;
- identify and reach a common view for innovation priorities aligned to national priorities;
- create a climate that encourages the sector to adopt innovative solutions to increase efficiency;
- create the cultural environment for innovation to flourish across the water sector;
- provide a mechanism for assessing and recognising successful innovation; and
- drive the water sector to be a leader in innovation, at home and abroad.

The terms of reference for the group are available on the Ofwat website.

2. Identifying and choosing priorities

In 2010, the group carried out an exercise to identify the areas of water and wastewater delivery where the water sector needs to prioritise its efforts to innovate. It is hoped that individuals and organisations within the sector will use them in planning their work.

The exercise was based on a literature review of the following documents.

- 'A road map of strategic R&D needs to 2030' (UKWIR, 2010);
- Water company strategic direction statements; and
- Road maps developed from activities by various research centres and knowledge transfer networks.

The exercise was also based on the ideas of individual members of the group.

Through a process of selection, the group ranked the areas where innovation is required in order of relative importance. The top 12 areas are set out in detail in the next chapter.

Appendix 1 contains the full results of the exercise.

3. The priorities

3.1 Reducing leakage

The level of leakage from the water distribution network affects the volume of water that needs to be collected, stored, treated and pumped. Traditionally, managing leakage is affected by both:

- the performance of the assets; and
- the operational capability to identify and repair leaking water pipes.

Although much progress has been made in managing leakage in the past 22 years, the technology and techniques applied remain relatively similar.

In order to meet future challenges, it would be desirable for the water sector to be able to significantly reduce leakage. This will require significant innovation in the:

- delivery of leakage management;
- design of networks; and
- efficient location and fixing of leaks, with minimal road and traffic disruption.

We believe innovation in this area could be further stimulated by the following measures.

- Developing sustainable and economic leakage management targets and approaches. These should include the aspiration to move to low (or near zero) leakage at an economic cost.
- Developing intelligent, low-leakage networks and techniques that provide increased operational and capital efficiencies.
- Developing and implementing technology that provides proactive and accurate leak detection and quantification.
- Developing and applying non-intrusive leak repair methods to reduce service disruption.
- Developing technology and processes that enable water network control and pressure management in real time.

The outcome we want is to fundamentally reduce the sustainable economic level of leakage in line with customer expectations.

3.2 Adapting infrastructure to a changing climate

As our climate changes, the stresses on the infrastructure we use to deliver water and wastewater services will change. For example, treatment works may be more prone to flooding where the intensity and duration of rainfall increases.

In addition, the demands we place on our infrastructure will also change as changing weather patterns alter the way we use services. For example, we may experience hotter and dryer periods that will increase our demand for water overall and at peak times. This could result in losses of pressure where demand exceeds supply, leading to service failures.

We believe innovation is needed in the following areas.

- Adapting the existing asset infrastructure and operational practices. This should provide increased resilience to deal with the extreme weather effects of climate change.
- Developing our understanding of the implications of climate change and adapting infrastructure to respond to the risks of future changes in the climate.
- Developing network controls and assets that operate in real time. These should provide enhanced resilience to customers through the effective operation of infrastructure assets.
- Increasing public knowledge on climate change issues.

The outcome we want is to develop economic solutions and management approaches to manage the risks of future climate change impacts. We also want to adapt our existing infrastructure, where necessary, to respond to these risks.

3.3 Economic regulatory reform to incentivise markets and innovation

Economic regulation has a clear part to play in creating the right frameworks to incentivise innovation and development of markets. We believe innovation in this area could be further stimulated by the following measures.

- Reviewing the existing economic regulations. This should provide a framework that encourages further innovation, particularly those that improve customer service.
- Exploring further opportunities to promote markets and encourage operational and capital efficiencies, particularly allocative and dynamic efficiencies.

The outcome we want is to develop innovative management approaches and incentives that overcome barriers to implementing and applying innovation within the water sector.

3.4 Environmental pollution prevention

The water sector has significantly improved its environmental performance over the past 22 years. But rising environmental standards, as well as the potential for demands on existing infrastructure to increase, means that innovation is needed both to maintain the existing level of performance and to improve it.

We believe the sector should focus on innovations that minimise environmental impacts caused by pollution incidents.

We believe innovation is needed in the following areas.

- Improving operational practice, wastewater asset capability and wastewater treatment compliance with the aspiration of moving towards zero environmental pollution incidents.
- Improving real time knowledge and control of water and wastewater systems to allow performance optimisation and operational response.
- Developing an overall proactive approach towards preventing environmental pollution.

The outcome we want is long-term sustainable reduction in recorded pollution events. Such reductions would need to be affordable and supported by customer expectations.

3.5 Sustainable drainage

In the future there is likely to be increased demand on wastewater infrastructure, particularly from meeting drainage needs. This is as a result of:

- changes in the frequency and intensity of rainfall events as a result of climate change;
- population growth; and
- the increase in impermeable paved areas within urban catchments.

We believe there are significant challenges for the sector to adapt existing wastewater networks, operational practices and customer incentives to deliver more affordable, sustainable and secure wastewater services.

The challenge is both technical and cultural as we seek economic and effective solutions to adapt the network, while meeting the needs of customers and managing the risk of flooding and pollution. We need the sector to innovate to effectively manage peak demands on wastewater systems. This includes innovation in the following areas.

- Cultural and technological change towards adopting and integrating sustainable urban drainage systems.
- Reducing property flooding by improving:
 - system operation;
 - integration with flood protection infrastructure; and
 - management of wastewater and drainage systems.
- Managing and controlling wastewater at source. This includes encouraging behavioural change by customers.
- Real time flood alert and operational responses to prevent and minimise the impact of flooding incidents.
- Developing alternative systems and operational methodologies to make use of the existing storage capacity within the wastewater network.

The outcome we want is long-term sustainable management of drainage. Such changes in management practice should be affordable and supported by customer expectations.

3.6 Increasing efficiencies in treatment processes and waste management

Over the years, there have been many technological advances in both water and wastewater treatment technologies. However, there is scope for improvement. For example, many of the processes and technologies use a lot of energy and generate carbon emissions.

We believe the sector should aspire to energy-efficient and carbon-neutral treatment solutions which produce no waste. The sector should aspire towards chemical-free water treatment solutions.

We believe innovation is needed in the following areas.

- Continued optimisation of water and wastewater treatment processes through efficient energy management.
- Working towards low-carbon or carbon-neutral treatment processes.
- Increasing energy retention from existing processes.

- Real time monitoring and control systems.
- Reducing the number of untreatable by-products, with the aim of achieving zero waste.
- Developing chemical-free treatment solutions.
- Develop cost-effective low-carbon solutions for desalination.

The outcome we want is long-term reduction in treatment costs, with reductions in both carbon and chemical usage.

3.7 Promote end user education – reducing water consumption and promoting sustainable disposal

In the future, balancing the supply and demand for water effectively and efficiently will require customers to use water more wisely. In order for this to happen, the sector needs customers to be well-informed and educated about the true value of water and its benefits. This will help encourage customers to make smarter lifestyle choices in reducing their daily water consumption.

We believe innovation is needed in the following areas.

- Improving our understanding of current customer behaviour and approaches that will reduce the average daily water consumption per person.
- Cultural and technological change to reduce overall water consumption.
- Promoting good customer practices to reduce any impact on society and the environment. For example, the impact on sewers (and the links to pollution and sewer flooding) as a result of incorrectly disposing of fats, oils and greases (FOG).

The outcomes we want are long-term reductions in per capita consumption and FOG disposal and blockages.

3.8 Reducing water supply interruptions

Water supply interruptions lead to loss of supply and subsequent societal disruption. The challenge for the water sector is to operate and maintain the water networks in a way which leads to minimal or no water supply interruptions for customers.

We believe innovation is needed in the following areas.

- Real time knowledge and control of networks to reduce the impact of asset failure on the service received by customers.

- Controlling strategic water networks to manage water supply-demand in real time.
- Improving operational practices and management procedures to reduce the likelihood and impact of loss of supply for customers.
- Employing intelligent assets and non-intrusive maintenance techniques to reduce customer disruption.

The outcome we want is the long-term reduction in supply interruptions to customers. These reductions should be economic and meet with customer expectations of value.

3.9 Comprehensive underground asset mapping

Much of the sector's existing maintenance of water and wastewater networks involves work on or near roads (the 'highway'). This has a risk for operational staff and other utility apparatus.

The sector should collaboratively develop asset mapping systems that can be comprehensively applied across all utility services. This will help:

- reduce the impact of maintenance in the highway; and
- improve productivity and customer service.

We believe innovation is needed in the following areas.

- Developing and implementing technology to accurately map the underground infrastructure of all utilities.
- Integrating engineering design co-ordination to enhance productivity and health and safety.
- Reducing unintended third-party utility service damage.

The outcomes we want are a reduction in unit costs and health and safety incidents through:

- the long-term reduction of activity in the highway;
- reduction in the time staff spend onsite; and
- reduction in third party damage.

3.10 Smart metering

Implementing smart metering could help increase water efficiency by encouraging customers to use water wisely.

We believe innovation is needed in the following areas.

- Developing and maximising the installation of self-powered smart water meters.
- Maximising water efficiency and providing relevant and informative information to customers to enable effective choices about water use to be made.
- Incentivising water-efficient behaviour by customers through advanced tariffs.

We want the following outcomes.

- The long-term cost-effective deployment of smart meters across the sector.
- Improvements in customer knowledge and understanding of water use to allow them to make water-efficient choices.

3.11 Sustainable abstraction

In order to use existing water resources more efficiently, the sector needs to develop sustainable abstraction and water resource management frameworks.

We believe innovation is needed in the following areas.

- More reliable forecasting in demand management.
- Applying real time control and water management, including investigating the use of real time licensing.
- Reducing the environmental impact of abstraction.
- Optimising efficiencies in overall abstraction and water treatment processes.
- Ensuring security of supply for customers, with the aspiration of having no hosepipe bans or drought orders.

The outcome we want is the long-term sustainable abstraction of water resources, which meet the needs of society and the consumer.

3.12 Strategic connections for water-stressed areas

One of the potential future challenges facing the sector is water stress in certain parts of the country. Addressing this challenge will require water networks and assets to be more adaptable and flexible to deal with the effects of water scarcity and drought. By having greater asset adaptability, the sector can plan water resources to prevent water stress.

We believe innovation is needed in the following areas.

- Developing strategic asset and infrastructure connections in water-stressed areas to increase resilience.
- Developing real time information to allow effective and timely choices to be made on water resource management.

The outcome we want is to meet the long-term needs of water-stressed areas in the most economic and efficient way, balancing risk and the availability of water resources, regardless of corporate or administrative boundaries.

4. Next steps

We believe that individuals and organisations across the water sector should use the priorities set out in this document to determine the direction of their future research and development work. This will help encourage the development of innovative solutions where they are most needed.

The Water Sector Innovation Leadership Group will continue to meet to discuss these priorities. We will examine the role of the water sector in delivering these priorities. We will also try to promote these priorities through the various incentives and frameworks within which the water sector operates. Where appropriate, we will seek to challenge and adapt these frameworks in order to continue to stimulate innovation.

The role of the group and its membership is expected to develop over time to be more inclusive of the sector as a whole. In particular, we want to broaden the leadership group's experience in other sectors in order to promote cross-sectoral innovation, learning and best practice.

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Appendix 1 List of areas where innovation is required

Priority areas	Score	How urgently is innovation required? ¹	Area of water and wastewater network where the innovation is required ²
Reducing leakage	19	Medium term	Water resources and water distribution
Adapting infrastructure for climate change	15	Short term	All areas
Economic regulatory reform to incentivise markets and innovation	9	Short term	All areas
Environmental pollution prevention	6	Short term	Wastewater and wastewater treatment
Sustainable drainage	5	Short term	Wastewater collection
Increasing efficiencies in treatment process and waste management	4	Short term	Wastewater treatment and waste management
Promote end user education – reducing water consumption and promoting sustainable disposal	4	Short term	All areas
Reducing water supply interruptions	3	Short term	Water distribution
Comprehensive underground asset mapping	2	Short term	Water distribution and wastewater collection
Smart metering	2	Short term	Water distribution
Sustainable abstraction	2	Short term	Water resources
Strategic connections for water-stressed areas	2	Short term	Water resources and water distribution
Working towards minimum use of chemicals in water treatment and drinking water	1	Short term	Water treatment
Flood alert and control technologies	1	Short term	Wastewater collection
Competitive tariffs – improved customer service	1	Short term	
Using efficient and cost-effective plant	1	Short term	All areas
Renewable energy production from treatment processes	1	Short term	Water and wastewater treatment
Fat, oils and grease – FOG	1	Short term	Wastewater collection
Cross-company use of water resources	1	Short term	Water resources
Working towards intelligent networks, real time asset performance monitoring and integrated emergency control	1	Medium term	All areas
Continual compliance with drinking water quality at an economic level	1	Medium term	Water treatment
Working towards capturing new water resources	1	Medium term	Water resources
Effective network pressure control for supply and demand management	0	Short term	Water distribution
Efficient sludge management working towards zero sludge	0	Medium term	Wastewater treatment

Innovation priorities for the water sector

Water efficiency – increasing water reuse and recycling	0	Medium term	Water resources
Sustainable low-maintenance assets	0	Medium term	All areas
Materials harvesting and recyclable products from waste	0	Medium term	Waste management
Cultural change towards sewer abuse	0	Medium term	Wastewater collection
Desalination of sea water	0	Long term	Water treatment

Key

¹Short term: 2010-15

Medium term: 2015-25

Long term: 2025-35

²Water resources

Identify sources of raw water, obtain permission for their extraction or collection and input it to the raw water distribution system.

Water treatment

Receiving raw or partially treated (non-potable) water from raw water distribution system and undertake treatment processes.

Water distribution

Transporting treated (potable) water from treatment sites to customer properties and new appointees. This activity includes intermediate storage facilities, such as reservoirs and storage towers, with possible further treatment taking place within the network.

Sewerage system/wastewater collection

Collecting sewage from customers and new appointees and transporting to treatment works.

Wastewater treatment

Receiving untreated sewage from the sewage collection system into treatment works, undertaking treatment processes and discharging treated wastewater into rivers and sewage sludge to treatment processes.

Waste management

The waste management process incorporates the following:

Sludge treatment

Collecting sewage sludge from sewage treatment processes and undertaking treatment procedures before transferring treated sludge to collection point for disposal.

Sludge disposal

Collecting treated sludge from collection point, onward transport and disposing of treated sludge in various forms including ash disposal, disposal to landfill, disposal of composted sludge, sludge cake disposal and export of treated sludge for disposal.



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