UK 2050 WATER INNOVATION STRATEGY

INNOVATION PRIORITISATION EXERCISE

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INTRODUCTION

All 19 UK water and waste water companies were recently invited to take part in an initial prioritisation exercise to begin exploring how to give an initial, high level view of their collective innovation priorities. To interpret the exercise as it was intended, it's really important to read this introduction to avoid any doubt about what it represents.

This exercise also allowed our partners Arup, Isle Utilities and Nesta as well as the water sector supply chain and wider sector stakeholders, to better understand the current perceived industry innovation challenges and their importance. This also provided water companies with a tool to help them understand which other organisations have similar priorities to them to support collaborative innovation and partnership working.

To produce the list of priority challenges, the seven innovation themes from the Water Innovation Strategy were subdivided into 31 broad challenges. Water companies were asked to prioritise these via a scoring system to reflect their current innovation requirements, paying particular attention to areas where they were more urgently in need of innovative solutions.

These scores were averaged to provide an industry innovation priority list. The list does not provide insight into the relevant importance of the broad challenges, but demonstrates the

areas where water companies as a whole are particularly seeking innovative solutions. If a challenge is ranked highly, it is a strong indication that water companies are generally very interested in innovative solutions in this area and are more likely to trial and adopt them. The lower a challenge is ranked, the more likely it is that water companies are satisfied that current tools and methodologies will enable them to achieve their goal or that it's seen as a lower challenge overall.

As this is a joint industry exercise, it does not represent the unique set of priorities and challenges of each individual water company. Each can and will have markedly different priorities to the list produced here.

Finally, the list reflects current priorities, which will undoubtedly change as the year progresses. Should this exercise prove useful, we would look to update this on an annual basis.
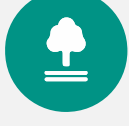
OUR THEMES

To provide focus and encourage accelerated change we have identified seven themes. These are the topics we have identified as our focus for innovation to respond to our future drivers and the long-term priorities of our customers.

These themes are opportunities for innovation both for the water sector and for other wider sectors across global geographies to inspire and encourage diverse collaboration.

In this report we outline the principle challenges for innovation in each of these themes and break these down into more specific tangible challenges that need to be met.

PROVIDING CLEAN
WATER FOR ALL

PROTECTING AND ENHANCING
NATURAL SYSTEMS

PROVIDING THE
SERVICES SOCIETY
NEEDS, EXPECTS
AND VALUES

DELIVERING
RESILIENT
INFRASTRUCTURE
SYSTEMS

UK 2050

ENABLING DIVERSE
FUTURE-READY PEOPLE
AND PARTNERSHIP
WORKING

ACHIEVING NET
ZERO CARBON

TAKING A WHOLE LIFE
APPROACH TO
RESPONSIBLE
CONSUMPTION AND
PRODUCTION

8 PRIORITY INNOVATION CHALLENGES

Broad Challenge
How might we redesign drinking water supply to be low impact and sustainable, maintaining excellent service while reducing the materials, energy and chemicals used in building, owning and operating water systems?
How might we develop and implement improved ways of monitoring water from catchment to tap?
Net positive - natural capital, net zero carbon and minimal waste
How do we monitor our assets in order to respond correctly to rapidly changing environments and unpredicted events?
How do we measure the current condition of our assets, accurately predict their deterioration and know when and how to intervene?
How can we decarbonise energy and transport emissions through avoidance, efficiency and alternatives to fossil fuels?
How might we sustainably eliminate leakage across water company networks and customers' pipes?
How might we better engage with our customers to change how they think and feel about water and to embed behaviours that show that customers value water as a scarce resource and treat it as such?

We need to innovate to build customers' trust and deliver transformational customer service.

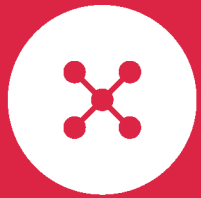| Broad Challenge	Specific Challenges
How might we better protect, serve, understand and support vulnerable customers and communities?	- How do we develop our understanding of the true extent and impact of water poverty across customers? - How do we develop water services that are accessible, affordable for all, protect vulnerable customers and lead to zero customers in water poverty by 2030?
How might we facilitate learning and engagement around the true value of water, at a societal, environmental and financial level?	- How to we develop an understanding of the true value of water among customers?
How might we encourage broader, richer and deeper collaboration with our customers and stakeholders from within and outside of the sector?	- How do we ensure that customers have trust and confidence in the service that the water sector provides? - How do we ensure that service provision is safe, transparent, and that customers and communities work with water companies to improve service and decision making? - How do we improve our customer engagement processes? - How do we create an open two-way dialogue with customers around issues of quality, service and vulnerability?
How might we build trust and dialogue as well as being truly open and transparent with the customers we serve?	- How do we proceed with creating national benchmarks for data sharing and collaboration? - How do we encourage and facilitate shared purpose and collaboration across the water sector? - How do we develop cross-utility partnerships? - How do we ensure that we are working collaboratively with the non-household market?
How do we encourage the sharing of broader environment and financial benefits with customers?	- How do we encourage the sharing of broader environment and financial benefits with customers?

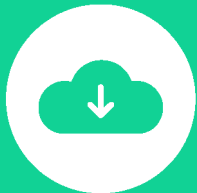| Broad Challenge	Specific Challenges
How might we develop and implement improved ways of monitoring water from catchment to tap?	- How might we develop and implement improved ways of monitoring water quality in potable water distribution networks? - How might we develop and implement improved ways of monitoring raw water quality to enable better management of water resources and abstraction? - How might we develop and implement improved ways of monitoring drinking water quality, including taste and smell to better reflect customers' experience of their drinking water?
How might we redesign drinking water supply to be low impact and sustainable, maintaining excellent service while reducing the materials, energy and chemicals used in building, owning and operating water systems?	- How might we develop and implement zero chemical & low energy treatment processes, while responding to evolving water quality standards? - How might we improve our upstream management of water quality to increase overall system efficiency and effectiveness e.g. catchment, abstraction management and reservoir management? - How might we more effectively maintain treated water quality through the distribution network to customer's taps e.g. removal of risk of ingress on existing and new storage points, cost effective identification and mitigation of lead services?
How might we ensure that UK water supply is reliable, with minimal interruptions or incidents and rapid services restoration in the event of failure?	- How might we develop and implement improved and non-invasive asset repair and maintenance in 'live' environments to ensure that water services are maintained during asset failure or restored as quickly as possible after failure? - How might we ensure that operations and maintenance activities do not increase risk of service deterioration or asset failure? - How might we ensure that all new assets are problem free when installed, and remain so throughout their economic life? - How might we develop and implement improved and non-invasive asset condition monitoring to enable us to confidently predict the onset of asset failure to allow delivery of timely intervention?
How might we create a constructive dialogue with stakeholders, based on mutual trust and clear communications, to create a shared ownership of safe, clean drinking water?	- How do we ensure responsibility for maintaining water quality is clear and all play their part in its protection (e.g. customers, landlords, plumbers, manufacturers and suppliers of sanitary ware, builders, building and trading standards, local authorities, water companies, regulators)? - How might we better engage all stakeholders (e.g. customers, appliance manufactures and retailers, builders and fitters, landlords, local authorities) to drive down PCC and address the barriers to the use of alternative water resources?
How might we develop and implement regulatory processes that enable the sector to reliably, affordably and sustainably provide enough water for all across the UK, now and in the future?	- How might we ensure that future regulation achieves an appropriate balance of risk for substances of concern, their public health impact and mitigation? - How might we develop and implement regulatory processes that enable innovative approaches for water supply to be deployed rapidly and safely ?
How might we adopt multi-sector adaptive planning for UK water resources to understand future trends like climate change and ensure that water systems are designed to accommodate the full range of demand scenarios & outages?	- How might enable a system-scale partnership approach to water management, collaborating across the sector and ensuring ownership and responsibility for water is clear and all play their part in its protection?

We need to develop, protect and enhance our environment, both above and below water, to build resilience to degradation and environmental changes

Broad Challenge	Specific Challenges
Net positive - natural capital, net zero carbon and minimal waste	- Optimising the use of land (natural capital, biodiversity, carbon neutrality) - Protecting water quality at source – integrated catchment management solutions - How can we optimise natural capital solutions to benefit both society and the environment - How do we take the opportunities the Environment Bill provides to work with others to optimise supply/demand balance and natural capital - Natural Capital Accounting - to make the use of nature-based solutions the norm
Environmental quality - minimising adverse impacts from wastewater	- Asset condition - how do we ensure the structural condition of sewers is known and maintained - How to ensure no deterioration in water bodies and zero pollution incidents - Asset capacity - how do we ensure sewers have the capacity to cope with new developments, infiltration and weather extremes - Asset operation - how best to monitor our sewers to enable proactive intervention and have sufficient resources to respond to incidents - How can we better control sewer content at source, including addressing missconnections cost-effectively - How to reduce water consumption, including increasing uptake of greywater and rainwater harvesting - How to reduce water consumption, including new methods to engage with customers and incentivise them to change their water behaviours - How to minimising losses from water treatment and supply systems to make the water supplies more drought resilient - How to use weather forecasts to raise awareness of risks to the availability of water supplies
Plastics - minimising harm from plastics	- Plastic residuals - how to ensure any effects of the plastics in our biosolids are quantified & have no negative impact on soil health - Plastic removal - how to ensure our treatment processes can effectively remove harmful plastics and / or recover them as a resource - Plastic avoidance - how to ensure the entry of harmful plastics into our products and water cycle is effectively controlled at source - Plastics measurement - how can we confidently identify, monitor & report the levels of harmful plastics through our operations & activities
How do we develop a resilient service with maximised social value at acceptable cost	- Develop catchment and other controls at source – to improve resilience and performance

We need to prepare our systems to be resilient to future changes and unknowns

Broad Challenge	Specific Challenges
How do we monitor our assets in order to respond correctly to rapidly changing environments and unpredicted events	- Smart water network system - Alarm rationalisation - Deploying the right resource to the right site at the right time - Low cost sewer monitors - Lifecycle regimes on assets balance, performance, cost and risk
How do we measure the current condition of our assets, accurately predict their deterioration and know when and how to intervene	- Understanding the condition of buried assets - Condition assessment of cast iron trunk mains - All potential asset interventions are based on risk - Risks of potential operational failures are reduced to zero
How do we ensure that we have the understanding and tools in order to confidently make long term strategic planning decision	- Asset resilience and predicting failure in the face of climate change - Long term strategic decisions are made with confidence - Reliable decisions are made over multiple time frames and systems - Organisations have the skills and culture to create value through asset management
How do we manage the replacement and renewal of assets cost effectively and minimise the environmental and social impact	- Sustainable commissioning of new large diameter water pipelines

We need to play our part in limiting global temperature rise to under 1.5C

Broad Challenge	Specific Challenges
How can we decarbonise energy and transport emissions through avoidance, efficiency and alternatives to fossil fuels?	- Low energy aeration technologies - Maximising energy generation from sewage sludge - Hydro electricity at sewage treatment works - Heat recovery at sewage treatment works - Alternative heat sources for sludge treatment processes (BQ outcome: Energy & transport) - Hydrogen production from bio-resources - New remote monitoring techniques and technologies – to reduce visit frequencies - Reducing transport emissions through collaborative working
How can we minimise emissions of methane and nitrous oxide through prevention, optimisation of treatment processes or capture from the air?	- N2O monitoring and active-control in activated sludge plants
How can we minimise embodied emissions associated with construction materials, consumables, and other products & services that we use?	- Low carbon concrete - Carbon neutral construction materials & methods - Reducing carbon and increasing resilience of water treatment chemicals
How can we reduce emissions related to customers' use of water and sewerage?	- Hot water use in the home - (BQ outcome: Customer behaviour outcome)

Broad Challenge	Specific Challenges
How might we sustainably eliminate leakage across water company networks and customers' pipes?	- How might we quickly and cost effectively locate all existing and developing leaks, especially low-level 'background' leakage? - How might we change how we operate and maintain our existing network to minimise new leaks? - How might we change how we design and install pipes to ensure all new pipe is leak-free? - How might we more accurately measure water quantity, from abstraction to consumption, to enable us to confidently quantify leakage and demonstrate when it is zero? - How might we make pipe repairs quickly, economically and with minimum disruption?
How might we better engage with our customers to change how they think and feel about water and to embed behaviours that show that customers value water as a scarce resource and treat it as such?	- How might we design and implement incentives and enforcement of responsible water consumption and enable grey water use more widely? - How might we better engage our customers to feel truly part of the water cycle and to ensure customers understand their role in reducing lost water and unnecessary consumption and are actively supported to do so? - How might we develop and roll-out low-cost metering to deliver insight on usage for domestic customers, while protecting customers' interests and privacy?
How might we maximise the recovery and reuse of resources to ensure enough resources for all, for ever, for example, by recovering energy and chemicals from water and wastewater processes and by-products?	- How might we develop and implement technologies to enable a wide variety of valuable resources to be recovered (e.g. energy, nutrients, chemicals, metals)? - How might we develop markets and value chains for raw materials and design & test novel business models for exploiting them? - How might we apply resource use and recycling approaches to drive social, environmental and economic capital gain for all?
How might we minimise consumption of finite virgin resources and maximise the use of recycled products, moving to a more circular, regenerative approach to water and wastewater operations and investment?	- How might we create methods and tools to evaluate the scale of consumption and production over the life cycle of assets and use these to redesign assets and processes with resource-reuse and zero-waste at their centre? - How might we improve the productivity of our existing assets and processes, reducing the resources required for treatment of water, wastewater and sludge and reducing materials used in capital maintenance? - How might we develop treatment process that do not rely on virgin chemicals e.g. using passive or nature-based solutions, catalysis, or energy efficient chemical generation and regeneration? - How might we achieve new drinking water standards without increasing our demand on resources? - How might we ensure the wastewater quality standards achieve a balance between local environmental benefits and wider impact on natural resources?
How might we achieve zero waste across water sector operations and capital investment by minimising inputs, recycling by-products and residuals and ensuring new solutions are designed to be zero-waste?	- How might we ensure that water sector waste regulation is underpinned by the circular economy, and producer responsibility / controls at source are fully effective? - How might we develop and implement technologies to enable all waste streams to be cost effectively recycled and resources recovered (e.g. screenings, effluent, biosolids, water treatment residuals, WEEE)

Broad Challenge	Specific Challenges
How do we ensure the whole sector is diverse, representative of wider society and has the right skills to build resilience and preparedness to adapt to emerging challenges?	- How do we implement training, upskilling, resource sharing and employment development programmes across the sector and between sectors outside of water, both in the UK and internationally? - How do we actively encourage and enfranchise diversity of thought, opinion and practice across new and existing members of our workforce to drive transformational innovation that creates economic, social and environmental value? - How can we upskill, attract and retain the best people, from diverse backgrounds, with the right skills to provide public value?
How do we enable improved collaboration between water companies, regulators, supply chains, SMEs, start-ups, academia, customers and other innovators?	- How can we collaboratively develop, fund and implement a National WaterCentre of Excellence? - How can we create a thriving 'water market' with active trading and equitable allocation of water resources between users? - How might we foster long-term partnerships across Public, Private, Academic and Third Sectors as well as communities and individuals that are built around trust, without barriers to collaborative endeavour? - How might we identify and communicate the shared values and mutually beneficial successes that unite disparate groups across the water production and consumption life cycle and encourage longer term buy in?
How do we improve the culture of innovation within the sector?	- How might regulators measure and incentivise innovation and service improvements based on social value and environmental long-term benefits rather than short-term economic returns? - How do we ensure our staff across the sector are empowered to create, develop and implement innovation, facilitated by the provision of time, space, resource, and leadership buy in and endorsement? - How do we facilitate new business models and broker new partnerships that enable and promote a successful innovation culture?