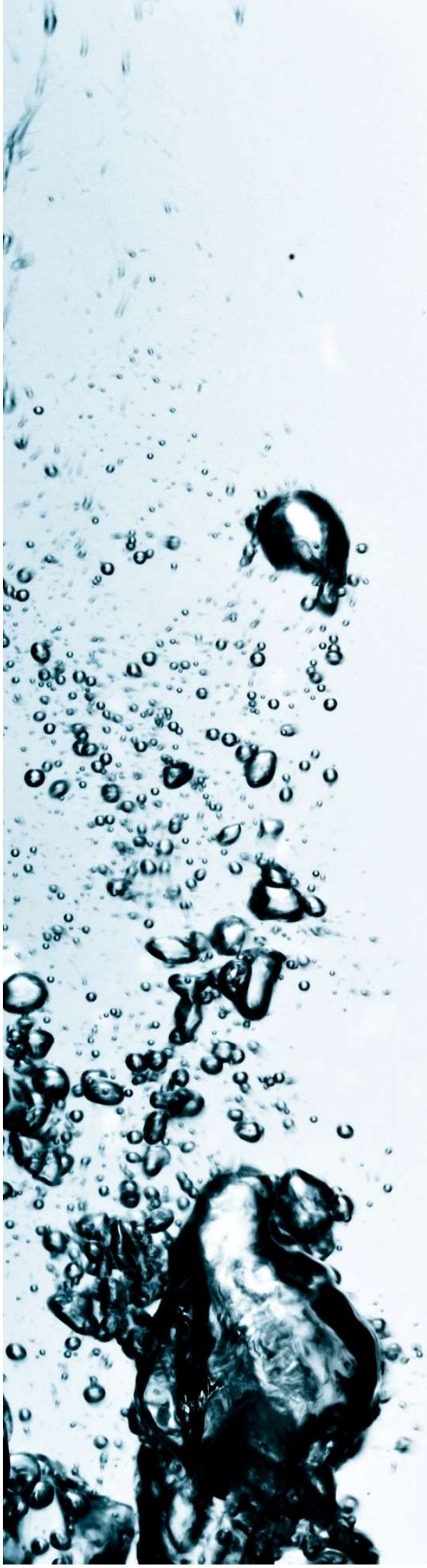

INNOVATING FOR A GREENER FUTURE:

European water service priorities

2023 update

EurEau

Our world is changing rapidly and so are water services. Innovation is key to guaranteeing the affordability of safe, sustainable and resilient water services for the decades to come. Water service providers are well aware of the challenges and have identified a number of technological and non-technological areas requiring particular innovation efforts with a view to meeting the goals of the European Green Deal. New challenges have also placed a particular focus on the need for innovation across the sector's supply chain to boost resilience as well as sustainability.

The research needs are compiled in this document and should help policy makers in designing research and innovation programmes in a way that responds to the real needs of drinking water and wastewater operators.

Innovation has multiple facets

Over the past decades, water services have improved significantly in terms of quality and accessibility. Today, 95% of European citizens have access to high quality drinking water while 82% of them are connected to wastewater treatment. Our sector has substantially increased the levels of health and environmental protection while reducing energy demand and embracing circular economy principles. Innovation has been a key enabling factor in this process.

Innovation is therefore a crucial tool to help the water sector meet the challenges of the United Nation's Sustainable Development Goals, adapt to climate change, become more efficient and comply with legislation at all levels.

For the water sector, innovation must not be limited to technological developments. In reality, innovation comprises other aspects including governance, recruitment, communication, public policy and partnerships. Although EurEau had approached the topic from a more technological perspective for a number of years, we see today that water utilities in nearly all Member States continue to face problems in accessing and implementing innovative solutions. It seems that this is not primarily caused by the lack of technological developments or solutions available but rather by the policy side which regulates the capacity of water utilities to invest (time and money) in innovation. The fact that utilities in a number of countries find it difficult to even maintain the infrastructure in place demonstrates how difficult it can be for them to invest money and time in innovation. Additionally, implementing innovative solutions needs to be accompanied with human resource management to adapt to the chosen solutions.

A stronger focus is needed on innovative public policy (regulation, economics), governance and partnerships to avoid legislative rules that set detailed and definitive requirements, leaving little room for innovation to meet demands besides regulatory compliance.

Significant amounts of mainly European but also national public funds are invested in the early stages of the innovation cycle, i.e. into research. The opportunity to turn

these efforts into tangible benefits for society can easily be lost if the research results do not reach the European water sector at an economically viable scale, or do not respond to its real-life needs. Innovation is therefore much more than an appendix to research. It is an integral part of the whole cycle and should be treated as such.

Barriers to innovation must be overcome

A number of barriers may slow down innovation in the water sector. They include

- ~ inflexible and prescriptive legislation;
- ~ missing LCA data showing that new solutions do not only address one particular issue, but provide wider sustainability benefits;
- ~ a lack of knowledge on innovative solutions;
- ~ a lack of innovative financing solutions;
- ~ technological solutions not adapted to the needs of water service providers;
- ~ a lack of public support.

Through its 37 national member associations, EurEau boosts a unique network of water and wastewater operators from across Europe. Through our **Innovation Sharing Platform (ISP;** www.eureau-innovation.org**)**, we provide a forum for European water services to share challenges, knowledge and practices with their peers from across the continent. Hundreds of experts from water operators have already registered.

We are also willing and able to ensure a better information flow between regulators, public support providers and water services. This document forms an important part of the effort. Moreover, we can also use our network to better inform water services of promising innovation cases.

Innovation priorities for EurEau members

Since we last asked EurEau members to report their proposals for innovation, **new innovation prospects** have been opened both by new possibilities and by new challenges.

The combined energy and supply-chain crisis the water sector experienced in 2022 has placed renewed focus on the possibilities for water services not just to increase energy efficiency, but to contribute to the resilience of the energy grid by becoming **energy producers** themselves. Difficulties encountered by the sector in procuring some indispensable materials, including chemical reagents, has stimulated new thinking about the sector's **supply chains**. The opportunities range from ensuring resilience in the face of shortages to envisioning fossil-free chemicals.

This is emblematic of a broader commitment to embed **sustainability** across all aspects of our work. We need better ways to control the greenhouse gas emissions from wastewater treatment processes and continue to look for ways to improve our contribution to circularity and reduce our waste. This commitment also requires our

sector to find better ways to raise **public awareness** of the fragility of water resources and the role they need to play in protecting them. This must involve not just demand management but also education on the safe disposal of wet wipes and medicines ('bin, don't flush').

The challenge of **emerging pollutants** is more than ever at the forefront of our members' minds, and is reflected in the need for new ways of stemming pollution at the source, notably by reaching out to industrial and other sectors to find solutions together. For those pollutants, like PFAS and microplastics, which are already present all around us, our sector needs innovative ways to remove them, especially from sewage sludge to boost its potential for beneficial use in the circular economy.

Finally, technological advances in other fields are opening up new possibilities for innovation in water management. The growing versatility of **drones** could be harnessed for uses ranging from hydrogeological modelling of groundwater resources to spotting leaks from inside water pipes.

Overall, EurEau members reported over 350 proposals for innovation. In order to present them all, we have grouped them by topic in the Annex. In the Annex, changes from our 2021 list are highlighted in red.

About EurEau

EurEau is the voice of Europe's water sector. We represent drinking water and wastewater operators from 32 countries in Europe, from both the private and the public sectors.

Our members are 37 national associations of water services. At EurEau, we bring national water professionals together to agree European water sector positions regarding the management of water quality, resource efficiency and access to water for Europe's citizens and businesses. The EurEau secretariat is based in Brussels.

With a direct employment of around 476,000 people, the European water sector makes a significant contribution to the European economy.

Innovating for a greener future – Annex

NB: Proposals first published in our 2021 paper on Innovation Priorities are listed in black. New proposals are in red.

Drinking Water

Protection of drinking water resources

Water resource planning in a changing climate

- ~ Identify, predict and protect water resources available (quantity and quality) for DW under CC scenarios
- ~ Investigate links to soil management and vegetation for the protection of drinking water resources in the face of climate change
- ~ Develop methods and concepts for water budgets within catchment areas to support water resource planning
- ~ Investigate new climate-related challenges for water quantity and quality in dams

Pollution: control at source measures

- ~ Investigate multistakeholder approaches for the implementation of control at source measures in the protection of groundwater resources
- ~ Investigate microbial contamination of DW resources by decentralised wastewater treatment system - cost-benefit analysis of different technical solutions.
- ~ Develop response-readiness for potential new bacteria and viruses (particularly in the face of antimicrobial resistance)
- ~ Develop comprehensive databases for micropollutants and other pollutants of emerging concern in wastewater

Protect/monitor catchment areas

- ~ Develop new surveillance technologies for DW resources protection (drones or others)
- ~ Deploy new sensor nets to monitor quantity and quality of groundwater for its protection
- ~ Develop new, fast, online quality analysis early warning systems
- ~ Develop new cost-effective strategies for catchment management

- ~ Develop new approach to investigate impact of multistakeholder activites on DW resources
- ~ Develop new approach to urban planning interacting with DW networks constraints
- ~ Develop new technologies to detect and eliminate invasive species
- ~ Use UAVs (unmanned aerial vehicles) equipped with imaging technologies for hydrogeological modelling of groundwater

Drinking water treatment technologies

General: Water Treatment Plant Level

- ~ Develop new solutions for DW treatment waste (PAC, GAC, brines/concentrates, sludge,…)
- ~ Develop new process and product controls for small decentralised drinking water treatment systems
- ~ Develop sustainable water treatment plants of tomorrow (robust, secure, easy to operate, with lower cost, energy and chemical consumption)
- ~ Develop flexible and resilient solutions to guarantee continuity of supply in case of shortages (of electricity, of chemicals, etc.)

Treatment process

- ~ Develop new technological processes and strategies for removing organic micropollutants
- ~ Develop treatment processes and strategies to secure water quality (minimise by-product formation and others)
- ~ Develop low chemical treatment technologies for DW
- ~ Develop new solutions for DW treatment waste
- ~ Explore the feasibility of alternative sources for DW
- ~ Predict the quality of water resources available for DW under CC scenarios to adapt treatment capacity
- ~ Develop better ozone generators (efficiency, energy consumption and cost)
- ~ Develop new treatment processes for denitrification Develop emergency treatment units for DW production
- ~ Develop new solutions for transformation by-products

Materials

- ~ Develop new filtration material (membranes) to avoid the use of chemicals and minimise waste
- ~ Develop PFAS-free membrane filtration materials

Monitoring of DW quality including disinfection

- ~ Develop fast bacterial detection techniques
- ~ Develop innovative cheaper sensors to perform accurate analyses of water
- ~ Develop new approaches to microbiological detection methods to trace contamination back to its source

Demand management

Consumption

- ~ Develop new approaches to control demand (Water-fit-for-purpose or more efficient distribution systems)
- ~ Develop new approaches to foster engagement of citizens (information and involvement) for better protection of DW resources (quality and quantity)
- ~ Develop new approaches to increase knowledge and acceptance of water-fit-for-purpose among citizens, farmers, industries, etc.

Optimising supply systems

- ~ Develop new strategies based on smart metering to optimise distribution networks (consumption patterns, pumping strategies, leakage or contamination detection...)
- ~ Develop new standardised and compatible sensors to monitor new threats on-line
- ~ Develop innovative strategies to guarantee continuity of supply
- ~ Develop adaptable solutions for the optimisation of supply systems (modular)

Maintenance of supply systems

- ~ Develop new ways of managing leakages in DW networks
- ~ Develop new rehabilitation techniques (no-dig)
- ~ Develop new tools for better synergies between infrastructure services (electricity, water, road…)
- ~ Develop new tools to assess the condition of hydraulic infrastructures and detect structural failures
- ~ Using unmanned vehicles for pipe inspection and maintenance

Other topics

Circular Economy

- ~ Develop new products from or uses of water treatment works sludge
- ~ Develop fossil-free water treatment chemicals to reduce the supply-chain climate footprint

Energy efficiency

- ~ Develop new technologies and strategies to optimise energy use in DW networks

Health & Safety

- ~ Assess the health risks of emerging pollutants in DW (microplastics, pharmaceuticals…)

Security

- ~ Develop IT tools for risk management (to contribute to water safety plans under the DWD)
- ~ Develop technologies and strategies to increase security of water treatment works and distribution networks

Wastewater

Sustainable wastewater treatment technologies

Circular economy

- ~ Investigating the resource factory concept - towards zero emission WWTP
- ~ Develop new chemicals that can be recovered and reused
- ~ Develop fossil-free wastewater treatment chemicals to reduce the supply-chain climate footprint
- ~ Develop source-separation sewerage for better reuse of stormwater

WW reuse

- ~ Develop new approaches to optimise WW treatment for water reuse

Treatment processes incl. substances of emerging concern

- ~ Develop new approaches and treatments for pollutants of emerging concern in WW
- ~ Develop new technical solutions for reaching low nutrient concentrations with low energy and chemical consumption and without creating (plastic) waste
- ~ Develop new strategies and techniques to reduce N_2O and methane emissions, including methane leaks from biogas production and upgrade processes
- ~ Investigate new biological processes including bioaugmentation to overcome current issues (sludge production, specific contaminants...)
- ~ Develop new treatments for odour control from WWTP

General: WWTP level

- ~ Develop new approaches of integrated wastewater management (treatment, monitoring and control) for small WWTP
- ~ Develop new approaches to optimise the use of current assets
- ~ Develop low cost approaches to wastewater management (opex and capex) Develop new approaches to reach sustainable WWTP
- ~ Develop new approaches to optimise WWTP through integrated modelling
- ~ Analyse balance between centralised and decentralised treatment systems at catchment scale

Materials

- ~ Develop PFAS-free membrane filtration materials for membrane bioreactors
- ~ Develop treatment equipment using materials more resistant to the aggressive conditions in WWTPs
- ~ Develop non-fossil-based plastic vessels, filters and media

Pollution: control at source measures

- ~ Investigate the impacts of pollutants of emerging concern on the water cycle, including impact on water services and the ways to mitigate them (2)
- ~ Develop solutions for decentralised treatment of pollutant of emerging concern at source (hospitals…)
- ~ Develop control-at-source strategies for industrial facilities connected to urban sewers and WWTPs (focus on PFAS)
- ~ Develop strategies to prevent PFAS-rich landfill leachate from reaching urban sewers and WWTPs
- ~ Develop pathogen-focused control-at-source measures to combat antimicrobial resistance
- ~ Share experiences of successful control-at-source public awareness campaigns on the "bin, don't flush" theme

Monitoring

- ~ Develop new methods for monitoring pollutants of emerging concern both in clean water and in wastewater
- ~ Develop standardized and reliable methods for monitoring emissions to air (particularly N_2O and methane)
- ~ Develop reliable on-line sensors for organic matter and faecal pollution
- ~ Develop decentralised monitoring solutions to trace pollutants of emerging concern back to the source

Energy efficiency

- ~ Develop new approaches to wastewater services to reduce energy consumption and maximise energy recovery
- ~ Investigate possibilities to optimise net energy consumption through better integration with the energy grid
- ~ Investigate the potential of thermal energy (heat production, heat use, district heating networks…)

Sustainable sludge management

P- and N-recovery

- ~ Develop new approaches to nutrient recovery from sludge, in particular new recovery technology processes for N and P from wastewater and sludge, which are low energy and require low / no chemical inputs

Energy recovery

- ~ Develop technologies to maximise energy production from sewage sludge

Biogas

- ~ Investigate the optimisation of co-digestion between sewage sludge and animal manure

Reduction of sludge quantities

- ~ Investigate the possibility to reduce the volume of sludge through new organism strains
- ~ Investigate ways to improve sludge dewatering

Pollutant removal

- ~ Develop new ways to remove pollutants of emerging concerns (in particular PFAS) from sewage sludge
- ~ Develop new technologies to recover chemicals from sewage sludge
- ~ Investigate PFAS concentrations in sludge, mapping differences and sharing successful mitigation strategies
- ~ Develop new sludge hygienisation methods to remove pathogens

Sludge to land application

- ~ Develop new ways to use sludge on land
- ~ Investigate the impact of the use of sewage sludge in agriculture
- ~

New outlets for sludge and recovered nutrients

- ~ Research EU-level market opportunities for recovered nutrient N & P
- ~ Explore the requirements and specifications for recovered nutrients so that new technologies to satisfy these requirements can be researched and tested
- ~ Research business models and 'market pull' mechanisms for recovered nutrients at the EU level to support ambition for food security and the Circular Economy

Sustainable urban drainage (SUDs)

Wastewater Network

- ~ Develop robust new approaches to optimise the level of asset service for both sewers and WWTP
- ~ Develop new approaches (modelling, monitoring...) for failure detection and rehabilitation of sewer networks
- ~ Develop new no-dig techniques for inspection, rehabilitation and separation of sewers
- ~ Demonstration project to show the efficiency and impact of the separation of networks (grey/black water)

CSO

- ~ Develop easy technical solutions minimising energy demand for managing CSOs in real time

SUDS & NBS

- ~ Investigate how to make SUDS the standard
- ~ Develop new treatment systems for the treatment of storm water
- ~ Develop new green infrastructure (materials, devices and design concepts) focused on cost effectiveness, flexibility and adaptability to different environmental situations
- ~ Develop monitoring to ensure long-term evaluation of SUDS
- ~ Develop techniques for underground storage, permeable surfaces and green roofs

Urban water management in a changing climate

- ~ Investigate new approaches for climate resilient urban water management (long-term and early warning system for flood security)

Other topics

Analytical methods

- ~ Develop cost-effective standardised methods to analyse microplastics in wastewater and sludge

Health and safety

- ~ Develop new approaches for health and hazard management for employees of the wastewater sector
- ~ Develop new approaches to public health through wastewater surveillance

Other topics

- ~ Develop new concepts for sustainable wastewater management: from control at source to resource recovery
- ~ Develop robust new approaches to optimise the level of services of assets for both sewer and WWTP Demonstration project to show the efficiency and impact of the separation of networks (grey/black water)

Horizontal Matters

Sustainable business models of the future

Management

- ~ Develop new ways of promoting innovations to decision makers

Operation

- ~ Develop coordinated approaches to enhance both energy savings and energy production from water services
- ~ Develop new approaches to promote and implement innovative solutions in the water sector
- ~ Investigate new business models for water services that combine better efficiency, better or new services and reduced cost
- ~ Investigate the effect of new ways of handling wastewater (separate collection for different quality)

Resource recovery

- ~ Explore the use of thermal energy from wastewater streams
- ~ Develop effective business models for resource recovery for water services

Water governance

Optimisation of water services

- ~ Develop new approaches to water services in order to foster sustainability
- ~ Explore new governance models to improve water services according to strategies at catchment level
- ~ Develop communication tools to transfer knowledge from problem owners to decision makers
- ~ Investigate solutions to improve ESG coefficients in the water sector

Trans-sectoral coordination

- ~ Develop new approaches to water services in order to foster sustainability (inter service cooperation)
- ~ Analyse the impact of climate change on water demand for different uses

Asset management

Asset management

Asset management

- ~ Develop new approaches combining data mining and real time communication for water asset management
- ~ Investigate the life cycle approach to water infrastructure
- ~ Explore new approaches to ensure reliability of the infrastructure
- ~ Investigate the sustainbability of water transfer on long distance

Technical solutions

- ~ Explore new approaches to ensure the reliability of existing infrastructure
- ~ Develop new technical solutions for monitoring and diagnosis of existing infrastructures
- ~ Develop software to integrate new sensors data for asset management

Digitalisation of the water sector

Sensors

- ~ Develop sensors and methodologies for the monitoring of all aspect of the water cycle (quality, quantity, different resources and different hydraulic conditions)

Communication

- ~ Develop new digital tools and services for water services to improve communication with customers

Asset management

- ~ Develop new methodologies to better use smart meters and optimise water transport and distribution networks
- ~ Develop standards that allow multi-vendor digital solutions to be interoperable
- ~ Develop a robust digital environment for sanitation management
- ~ Develop modular and interoperable solutions to optimise every aspect of the water cycle
- ~ Promote the use of Big Data, digital twins and AI in every aspect of water management
- ~ Develop robots for inspection, operation, safety trainaing and assistance of operators

Resource management

- ~ Develop universal and flexible digital solutions for water services able to operate in various conditions and environments
- ~ Develop a digital environment and data treatment capabilities to optimise water treatment, water distribution and wastewater collect and treatment
- ~ Develop new methodologies to use big data to optimise WWTP controls
- ~ Develop new tools to capture external factors and input water resource management
- ~ Develop the use of drones in water infrastructure management
- ~ Develop integrated methodologies to monitor water quality and quantity from sources to sea

Data management

- ~ Develop methodology to sort valuable data in already available data to improve water infrastructure management
- ~ Develop a digital environment and data treatment capabilities to optimise water treatment, water distribution and wastewater collect and treatment
- ~ Develop IoT and RTC approaches into the everyday business of water services
- ~ Develop new methodologies to use big data to optimise the control of WWTP
- ~ Developing algorithms and software tools to model, forecast and simulate water acquisition and control systems

Security of the water sector

Data protection

- ~ Develop methodologies to protect IT/OT infrastructure of water services against cyber attacks

Asset protection

- ~ Develop methodologies and techniques to protect water infrastructure

Demonstration platform & living labs: operational experience for research and innovation projects

Pollutant removal technology

- ~ Demonstrate technologies for microplastic removal in rivers

Asset Management

- ~ Promote the implementation of new treatment technologies within water services infrastructure

Communication

- ~ Develop and test new ways of communicating with customers

Circular Economy

- ~ Implement medium scale pilots to demonstrate the feasibility and interest of separating wastewater lines

Human Resources Management

Recruitment strategies

- ~ Investigate drivers and bottlenecks to employ qualified workers in the water sector
- ~ Develop new models for incorporation of HR into asset management

Technology

- ~ Investigate the inclusion of new technologies to facilitate working conditions in water assets
- ~ Investigate how technologies can be used to improve HR intelligence

Education and competences

- ~ Develop high level and transgenerational profiles for data management in the water sector
- ~ Explore centralised education for the water sector at EU Level
- ~ Explore new ways of keeping practical experience in water treatment and management inside water services
- ~ Explore AI in HR for water services

Communication

Sustainability

- ~ Explore driving forces that make the public engage in sustainability and transfer it to the water sector
- ~ Integrate sustainable education into the training of water sector professionals

Consumers

- ~ Develop new communication methods to treat information and feedback from water services customers (bottom-up)
- ~ Explore new communication methods to improve information to customers (top-down)

Security

- ~ Develop new ways to manage crisis communication through new technologies

Join forces

- ~ Develop new approaches to communication fostering interservices cooperation

Climate change adaptation and mitigation

Technology

- ~ Develop technical solutions to reduce the CO2-footprint of water services

Effect on assets

- ~ Develop new approaches to make existing assets resilient towards climate change
- ~ Develop models and tools to design resilient assets

Resource management

- ~ Develop new approaches to integrate water resource protection in the adaption to climate change effect
- ~ Investigate the effect of climate change on the quantity AND quality of water resources
- ~ Develop new approaches to make cities resilient towards climate change

Emerging issues related to climate change

- ~ Investigate the effect of climate change on the quantity AND quality of water resources

Pollutants of emerging concern and AMR – Environmental impact and user responsibilities

Impact and pathways

- ~ Investigate the impact and risks of contaminants of emerging concern and derive sound monitoring requirements
- ~ Investigate microbial resistance in water resources

Asset assessment

- ~ Develop holistic approaches on the impact of extra treatments at WWTP level
- ~ Develop decision tool for pollutants of emerging concerns based on environmental impact and size of the WWTP

Control at source

- ~ Explore new approaches to reduce the use of substances of emerging concern
- ~ Develop new methodologies to map the main sources of contaminants of emerging concern
- ~ Develop new methodologies to analyse consumption patterns of contaminants of emerging concern
- ~ Develop new green substances to replace substances of emerging concerns
- ~ Explore new approaches for a holistic assessment of chemicals in the environment

Technology

- ~ Develop new technologies to remove pollutants of emerging concern
- ~ Develop green drugs that will maintain the effect but minimise the effect on the environment
- ~ Develop low cost monitoring devices for pollutants of emerging concerns

Analytical methods

Sensors

- ~ Develop new sensors for rapid screening of chemical substances, rapid bacteriological analyses, on-line monitoring of contaminants of emerging concern
- ~ Develop sensors for taste and odour control in DW

New approaches to analytics

- ~ Develop new and unified existing methods that use existing data to optimise information collection and improve water system management
- ~ Explore the use of different technologies (like LIDAR) for flow measurements

Standards development

- ~ Develop cost-effective and reliable analytical methods for micro and nano plastics in different matrix (mass and particle count)
- ~ Develop cost-effective and reliable analytical method for polar compounds
- ~ Develop cost-effective and reliable bio-assays
- ~ Deploy new microbial analytical methods
- ~ Develop cost-effective and reliable analytical method for PFOS, PFOA, PAH & pesticides aligned to legislation with suitable LOQ & LODs

Laboratory working tools

- ~ Develop fully automated robotic labs

Maximising energy efficiency

Energy management tool

- ~ Develop new tools for energy consumption assessment and diagnosis to optimise energy consumption
- ~ Develop new tools to optimise thermal energy generation from water infrastructure

Treatment

- ~ Develop new technologies for energy generation from sewage sludge
- ~ Develop new approaches for thermal energy recovery from water infrastructure
- ~ Develop new approaches to energy efficiency and carbon footprint reduction
- ~ Develop new approaches for energy generation from water mains

Synergies

- ~ Develop new approaches to reuse of chemicals in water processes
- ~ Develop new uses for biopolymers with a view to replacing current synthetic polymers
- ~ Develop common approaches with various industries to optimise the use and reuse of materials and chemical in water services

Other topics

- ~ Develop new ways of collecting information on heavy rains and cloud bursts to better manage sewer networks
- ~ Foster research and innovation in the industrial sector to favour upstream measures and avoid contaminants ending up in water systems
- ~ Analyse Circular Economy opportunities for the water sector
- ~ Develop new tools to optimise both energy consumption and generation in a holistic way
- ~ Encourage on-shoring of the supply chain to ensure European self-relianc