ZeroPollution4Water

Cluster event

4 December

9:00-13:30

WKE Water Knowledge Europe

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ZeroPollution4Water Cluster event I 4 December 2025

State of the art of the cluster

University of Coimbra

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https://h2oforall.eu/

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UNIVERSIDADE D COIMBRA

Rui C. Martins

Coordinator of H2OforAll

H2OforAll

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Cluster was presented for the first time at the Water Knowledge Europe event on the 19th of October 2023 in Brussels.

Opportunity to discuss the actions to promote the adotpion of results of EU-Projects and their contribution to policy development

Innovative tools to control organic matter and disinfection byproducts in drinking water.

The intoDBP project, funded by the EU, focuses on disinfection by-products (DBPs) formed during water chlorination. It develops innovative tools for water quality management, emphasizing cost-effective sensors and analytical methods. intoDBP aims to understand DBP precursors, address pollution and risks, and promote sustainable consumer behavior. The project engages society through surveys, contributes to climate change adaptation, and enhances water treatment.

Understanding groundwater Pollution to protect and enhance WATERquality.

The UPWATER project addresses the widespread issue of groundwater pollution by identifying effective regulatory and legislative preventive measures and by developing cost-efficient methods to measure pollutants, identify their sources and to mitigate the pollution. UPWATER focuses on the validation of these methods in three case studies in different EU climates and aims to develop hydrogeological models for decision-making scenarios, considering multiple stressors and climate change projections. Expected outcomes include the adoption of preventive measures, scaled-up bio-based solutions and updated chemical priority lists.

TOolkit for aDaptable, Resilient INstallations securing high Quality drinking water

The ToDrinQ project addresses the impact of climate change and increased pollution on drinking water quality. The project aims to develop real-time water quality monitoring technologies and innovative treatment systems, along with interoperable decision tools. These efforts support evidence-based treatment plant design and enhance operational awareness and response in the overall water system.

Innovative Integrated Tools and Technologies to Protect and Treat Drinking Water from Disinfection Byproducts (DBPs)

The H2OforAll project focuses on disinfection by-products (DBPs) that result from the interaction of disinfectants like chlorine with natural organic materials in water. It aims to develop cost-effective DBP sensor monitoring devices, model contaminant spread, study toxicity and environmental impact, and propose safeguarding measures for the drinking water chain. The project also works on innovative water treatment methods to remove or prevent DBPs, and it aims to create a central knowledge base with reliable data on DBPs in Europe and their effects.

Preventing groundwater contamination related to global and climate change through a holistic approach on managed aquifer recharge

MAR2PROTECT project confronts groundwater contamination resulting from climate change and global changes, with a focus on sustainable water management to meet zero pollution goals by 2030. It employs an innovative managed aquifer recharge (MAR) approach, utilizing the M-AI-R Decision Support System (DSS) that incorporates artificial intelligence (AI) to assess and enhance groundwater quality and quantity..

Climate-resilient management for safe disinfected and non-disinfected water supply systems

SafeCREW project addresses the challenge of supplying safe drinking water in the face of climate change. It aims to develop new methods for monitoring, treatment, and risk assessment, particularly in disinfection and organic substance removal, safeguarding water quality

Taking action to prevent and mitigate pollution of groundwater bodies

NINFA project confronts groundwater pollution by developing an early-warning decision support system and knowledge database, the NINFA Platform. This innovation enhances groundwater management by expanding knowledge on water flows and the behavior of emerging contaminants like pharmaceuticals and microplastics, safeguarding this vital resource.

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The problem

Diffuse pollution is still a significant pressure that affects 35% of the area of groundwater bodies, while quality standards (pesticides, herbicides, etc.) were exceeded in 15% of the groundwater bodies studied. Climate change and increasing water demand will exert significant pressures on groundwater quality.

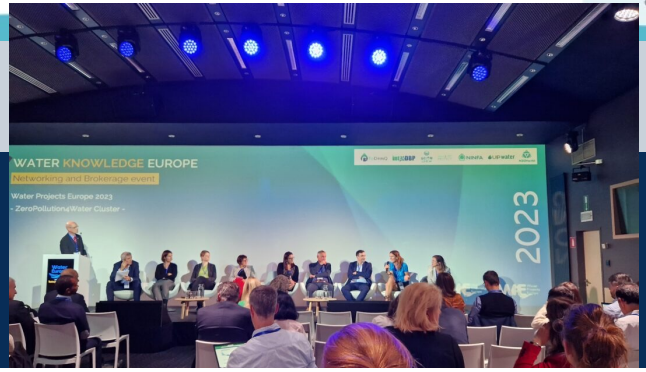
Furthermore, detrimental effects of natural/human-made disasters and increasing water temperatures due to climate change could deteriorate the quality of drinking water sources by favouring the conditions for enhanced eutrophication leading to algal and cyanobacterial outbreaks as well as pathogen development or the spread of invasive species. Emerging concerns are also rising at the level of drinking water treatment and distribution, notably in relation to disinfection operations, materials and products, ageing infrastructure, biofilm growth and possible harmful effects of unintentionally formed by-products and metabolites.

ZP4WC Objectives

Capitalisation of R&I achievements and future needs assessment.

Production of common policy briefs or policy recommendations, based on the evidence.

Demonstration of effective water management practises via case studies.



Working groups

The Cluster Work is currently organised in six Working Groups covering the variety and potential of the cluster members.

ZP4W Cluster Management and Coordination

Responsible for the cluster's internal and external action planning. It will prepare, validate and review the cluster's strategy and action plan on annual basis.

Communication

It will develop and implement a comprehensive communication and outreach action plan for the ZeroPollution4Water Cluster.

Technology and Innovation

This group will identify and develop innovative methods and technologies for reducing and managing water pollution.

Policy Advisory

It will analyse the EU's policy and regulatory landscape for water pollution and management and find potential for the ZeroPollution4Water Cluster.

Data Management and Sharing

This group will identify and discuss existing frameworks for drinking and groundwater, and will establish links with the ICT4Water Action Group on data sharing to align common contributions to European green dataspaces.

From R&I to Impact

They will facilitate the deployment of a cutting edge competitive technologies, governance models and best practices in the field of zero pollution for drinking water and groundwater.

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Joint Events
Webinars open to the public (7)
Internal webinars (4)
Workshops online (2)
Workshops back to back (3)
Winter School (1)
EU Green Week Events (3)
Exhibition ”Water, an unfiltered exhibition” (2)

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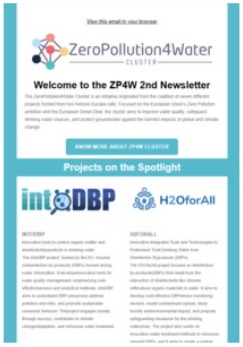
Newsletters

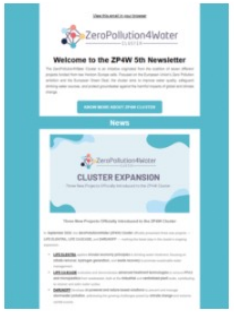
Newsletter 1



Newsletter 2

Newsletter 3

Newsletter 4



Newsletter 5

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TECHNOLOGY AND INNOVATION KNOWLEDGE HUB

Knowledge Hub:

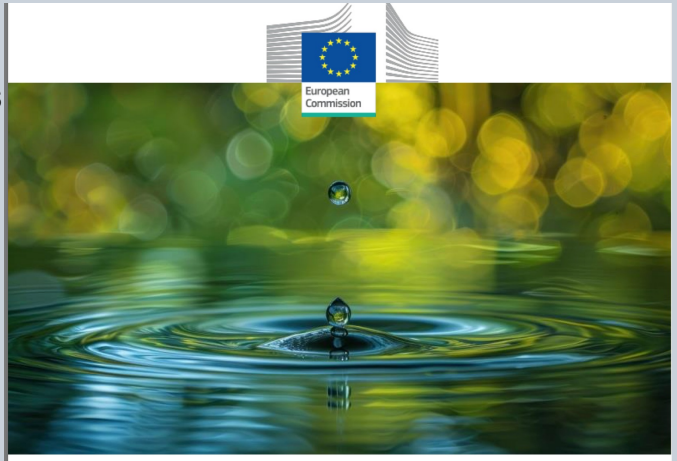
Shared information on Technologies (sensing/monitoring systems, water treatment approaches,...)

Overview and Inventory of 32 case studies in drinking and groundwater

Definition of the key challenges, monitoring/sensing, and treatment Technologies (already existent and what is being tackled by the project).

What do the projects have in common?
How do they complement?
How can they cooperate to lead to impact?

Figure 1: Map of the case studies (credits: Feuga). Black dots: groundwater related case studies. Red dots: drinking water related case studies.).



ZeroPollution4Water Cluster: the overview and the inventory of 32 case studies in drinking and groundwater

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2 Review Papers Joining the Efforts of all the Projects:

- Review on DBPs Analytics

“Holistic overview on disinfection by-products formation and analytical assessment”

- Review on Contaminants of Emerging Concern in Soils and Groundwater

"Advancements in Understanding and Addressing Emerging Contaminants in Soil and Groundwater Systems: Modelling, Risk Assessment, and Treatment Strategies”

Both under preparation!

White Paper:

Safe drinking water production in view of global threats including climate change. Technological solutions and gaps.

1. Introduction .....
2. Surface water quality .....
3. Groundwater quality .....
4. Drinking water distribution networks .....
5. Human health risk assessment .....
6. Adaptation strategies .....
7. Governance .....
8. Conclusions and future considerations .....
9. Further information .....

Figure 1. Summary of policy recommendations for enhancing EU drinking water resilience

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2 Policy Briefs! - Based on the Know-How shared by the projects

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Joint Policy Brief

Preventing groundwater contamination and securing drinking water quality

Recommendations

- Adopt management strategies and tools (e.g. DSS), based on detailed knowledge of groundwater resources uses and renewal rate, to effectively mitigate the effects of climate change (with special focus on drought and extreme events)

Recommendation extracted from the first deliverables of intoDBP and H2OforAll (c.f. part II):

- Develop a flexible regulatory framework for DBPs including iodinated and nitrogen containing DBPs (I-DBPs and N-DBPs).
- Safety Data Sheet – accessibility of information and better coverage.
- Invest in R&I projects to develop cost-effective technologies for real-time data acquisition and removal of micropollutants, pathogens and DBPs.
- Gain better knowledge about the situation and impact of new Contaminants of Emerging Concern (CEC) (e.g. through mapping) in terms of social aspects and potential policy measures to take.
- Incorporate in future R&I calls: living labs, strong training and awareness-raising programmes for society and all stakeholders particularly focused on CECs.
- Clarify and improve data requirements and management, particularly regarding the identification and monitoring of different antibiotic resistant genes (ARG's) and their impact on health.
- Invest in drinking water infrastructures, their design and operation to improve the resilience of our system.
- Improve the planification of wastewater reuse at basin level, including with aquifer recharge.
- Support biobased and nature-based mitigation solutions with a risk assessment.
- Minimise the pollution of micropollutants, including microplastics, pathogens and DBPs in the drinking water networks.

on the web Frame

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products to Help Ensure Trust in Tap Water

Table 1 Key recommendations

	Key Recommendations
Consider proactive measures against climate-induced challenges	• Reduce water residence time in the distribution network[4] • Encourage flexible and adaptive water treatment processes • Ensure tailored solutions to the local and regional contexts.
Support investment in water infrastructure	• Invest in DBP precursor and DBP removal methodologies • Encourage monitoring and early warning systems • Address infrastructure issues such as the safe maintenance of pipelines • Improved systems flushing and mixing in tanks • Encourage maintenance of domestic installations.
Communicate smartly with the civil society	• Ensure transparent data sharing and easy access to data • Replicate successful societal initiatives
Upgrade the EU water acquis and guidance to the new challenges	• Establish and enforce regulatory limits for newly identified and currently unregulated DBPs • Encourage proactive planning and source water pollution protection measures.

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Promotion of the Policy-Briefs

•Water Innovation Europe 2025 - end of October in Copenhagen

•Water Knowledge Europe 2025 - same as WIE2025

• Grodan event on water and agriculture. The topic of DBPs arose regarding water reuse for agricultural purposes.

Several Bilaterals meetings (close door) with some Members of the EU Parliament to promote the topic (e.g.MEP Bosse, MEP Bajada, MEP Bentele), idem with the Committee of Regions (e.g. climate unit).

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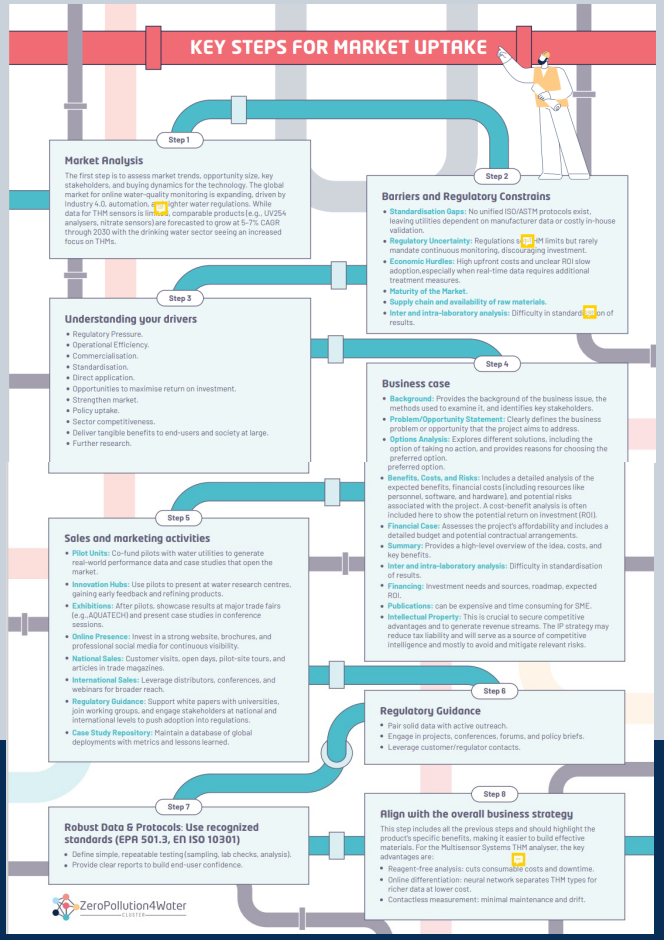
Final report on "Recommendations for Market Uptake of Selected Technologies"



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Case Study: Key steps for market uptake of the THM Analyser

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Editor: Daniela Meilmann

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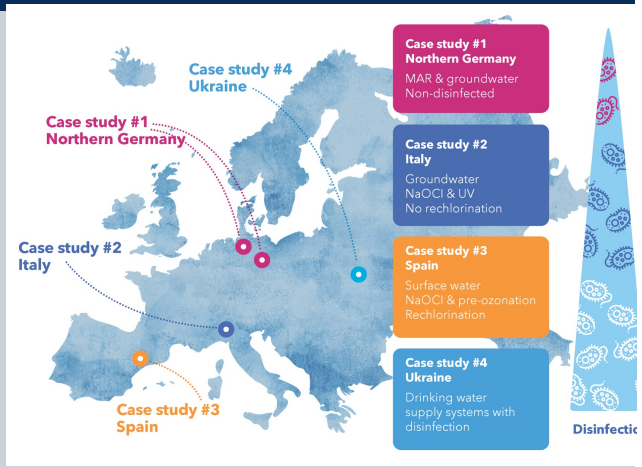
Climate REsilient management for safe disinfected and non-disinfected Water supply systems



Methods	16 new sulphonated DBPs identified
	Electronical nose THM sensor developed
	New toxicity CALUX tests established
Treatment	Four case study sites: applied, evaluated, optimised
Transfer	Methods, EU legislation, Models (esp. HopOn NUWEE Ukraine)
Coming	Integrated Risk Framework, Guidelines, Policy Briefs

safe CREW

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Toolkit for Adaptable, Resilient Installations Securing High Quality Drinking Water

- Developed 5 hard sensors for on-site monitoring of pathogens, microbial contamination, heavy metals, nutrients and pesticides
- Developed 10 soft sensors for monitoring of water quality in source water and treatment for drinking water
- Developed a web-based Design Support Tool for drinking water treatment
- Tested two innovative treatment technologies for removal of organics and PFAS in drinking water treatment.

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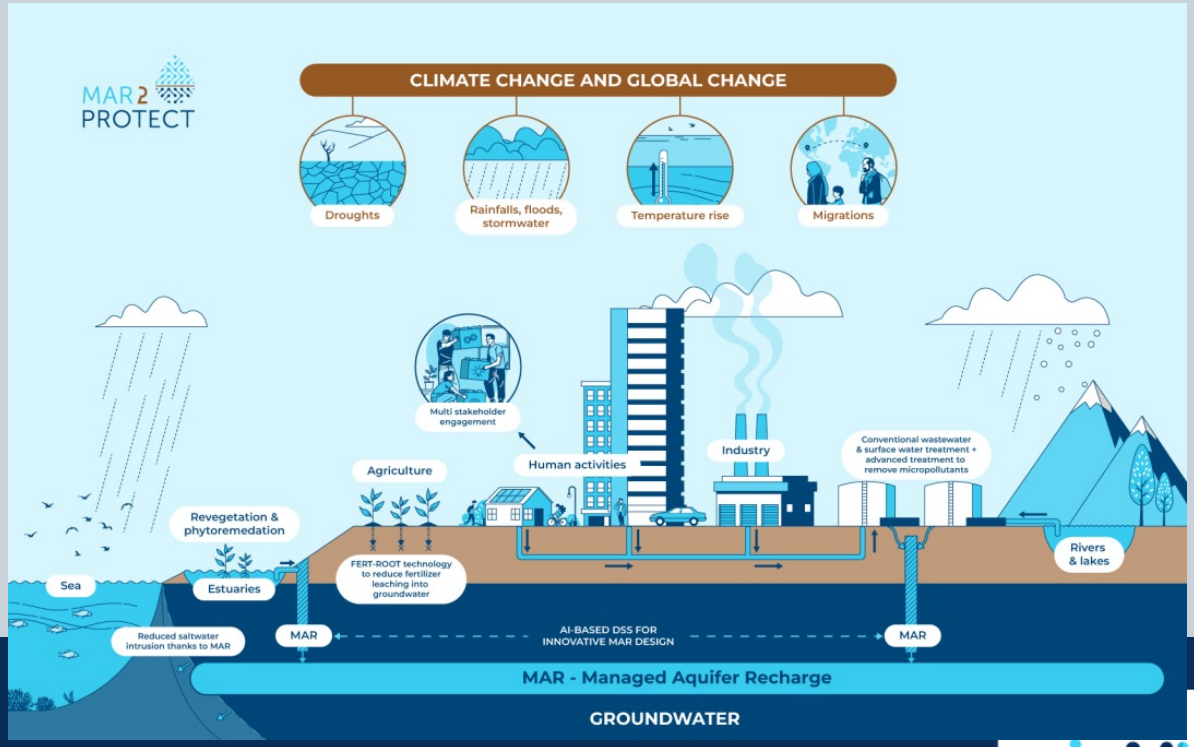
Preventing groundwater contamination related to global and climate change through a holistic approach based on managed aquifer recharge

MAR2 PROTECT



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Taking Actions to Prevent and Mitigate Pollution of Groundwater Bodies

Technologies for metal recovery (PGE) and pollutant removal from urban runoff
(NBS+AOP)

✓ Technologies to minimize nutrient and pesticide leaching in agriculture (MAS+MBBR+AOP+BIOCHAR)

✓ Integration of technologies (BF+AC+AOP) for water reuse in wastewater treatment plants (WWTP)

✓ Analytical methods for contaminant quantification in GW

✓ Combined water flow and quality sensors

✓ Methodology for HyGenTox Chip bioassay

✓ Citizen engagement strategy and social gaming desig

NINFA

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Understanding groundwater Pollution and enhance WATERquality

Nature-based solutions (NBS):

- Bioelectrochemical wetlands (filled with biochar and planted with Phragmites)
- Moving bed biofilm reactor plus biofilter

GW monitoring, priority list & risk assessment

- 2 monitoring campaigns carried out in Stengaarden dumpsite, Denmark). Novel ceramic passive samplers (TRL 7) showed very similar results as grab samples, and may be equally deployed to monitor pesticides.
- 6 monitoring campaigns carried out in Besos and in Athens, respectively.
- Priority list recommendation includes chemicals like metformin, losartan, benzotriazole, melamine, tris(chloropropyl) phosphate (TCCP), trifluoromethane sulfonic acid, 2,4-dichlorophenol, 4-chloro-2-methylphenol
- GW risk assessment ongoing

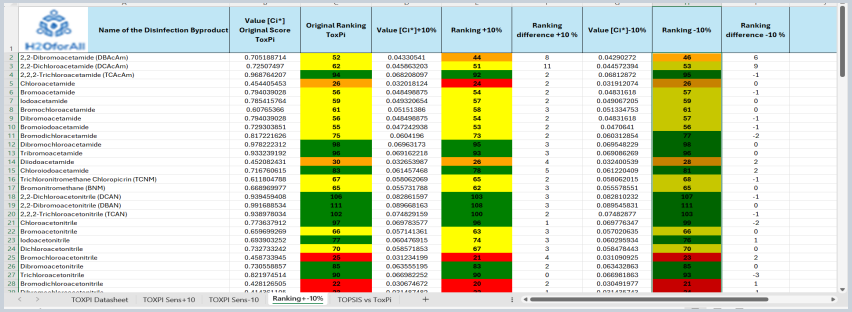
Governance and policy options (GPOs) defined in the three case studies

- GPOs created based on most effective preventive measures, elucidated together with local stakeholders, and technological solutions, including NBS
- GPOs ranked by multicriteria decision analysis (MCDA) using criteria that were selected and ranked by local stakeholders
- novel GW models deployed to model the effect of GPOs. NBS become a strong recommendation in the Besos and Athens.
- 3 local/regional policy briefs in work

Innovative tools to control organic matter and disinfection byproducts in drinking water

Relevance	- 15 partners, 4 Case studies with water quality challenges with field activities and local stakeholder engagement. - Novel catchment forecasting and protection measures. - Pilot plants with the novel MITO3X® treatment technology in Spain and Cyprus. - Development of innovative sensor technologies and distribution network modelling. - Public engagement and questionnaires to investigate attitudes towards drinking water. - Strong international collaboration within the ZeroPollution4Water Cluster, informing policy makers.

Innovative Integrated Tools and Technologies to Protect and Treat Drinking Water from DBPs



	Name of the Disinfection Byproduct	Value [CI*] Original Score ToxPi	Original Ranking ToxPi	Value [CI*]+10%	Ranking +10%	Ranking difference +10 %	Value [CI*]-10%	Ranking -10%	Ranking difference -10 %
2	2,2-Dibromoacetamide (DBAcAm)	0.705186714	52	0.04330541	44	8	0.04290272	46	6
3	2,2-Dichloroacetamide (DCAcAm)	0.72507497	52	0.045863203	51	11	0.044573394	53	0
4	2,2,2-Trichloroacetamide (TCAcAm)	0.968764207	94	0.068208097	92	2	0.06812872	96	-1
5	Chloroacetamide	0.454405453	26	0.032018124	24	2	0.031912074	26	0
6	Bromoacetamide	0.794039028	56	0.048498875	54	2	0.04831618	57	-1
7	Iodoacetamide	0.785415764	59	0.049320654	57	2	0.049067205	59	0
8	Bromochloroacetamide	0.60765366	61	0.05151386	58	3	0.051334753	61	0
9	Dibromoacetamide	0.794039028	56	0.048498875	54	2	0.04831618	57	-1
10	Bromoiodoacetamide	0.729303851	55	0.047242938	53	2	0.0470641	56	-1
11	Bromodichloroacetamide	0.817221626	75	0.0604196	73	2	0.060312854	77	-2
12	Dibromochloroacetamide	0.978222312	98	0.06963173	95	3	0.069548229	98	0
13	Tribromoacetamide	0.933239192	95	0.069162218	93	3	0.069088269	95	0
14	Diiodoacetamide	0.452082431	30	0.032653987	28	4	0.032400539	28	2
15	Chloroiodoacetamide	0.716760615	82	0.061457468	78	5	0.061220409	81	2
16	Trichloronitromethane Chloropicrin (TCNM)	0.611804788	67	0.058062069	65	2	0.058062015	68	-1
17	Bromonitromethane (BNM)	0.668969977	85	0.055731788	82	3	0.055578551	85	0
18	2,2-Dichloroacetonitrile (DCAN)	0.939459408	106	0.082861597	103	3	0.082810232	107	-1
19	2,2-Dibromoacetonitrile (DBAN)	0.991688534	111	0.089668163	108	3	0.089545831	111	0
20	2,2,2-Trichloroacetonitrile (TCAN)	0.938978034	102	0.074829159	100	2	0.07482877	103	-1
21	Chloroacetonitrile	0.773637912	97	0.069783577	96	1	0.069776347	99	-2
22	Bromoacetonitrile	0.659699269	66	0.057141361	63	3	0.057020635	66	0
23	Iodoacetonitrile	0.693903252	75	0.060476915	74	3	0.060295934	74	1
24	Dichloroacetonitrile	0.732733242	70	0.058571853	67	3	0.058478443	70	0
25	Bromochloroacetonitrile	0.458733945	25	0.031234199	21	4	0.031090925	23	2
26	Dibromoacetonitrile	0.730558857	63	0.063555195	63	2	0.063432863	63	0
27	Trichloroacetonitrile	0.821974514	99	0.069082252	96	0	0.068981863	93	-3
28	Bromodichloroacetonitrile	0.428126505	22	0.030674672	20	2	0.030491977	21	1

TOXPI Datasheet | TOXPI Sens+10 | TOXPI Sens-10 | Ranking+-10% | TOPSIS vs ToxPi

- Legal framework (EU and National)
- Management of drinking water (at national level)
- Preventative measures (e.g. risk Management)
- Context of climate change

Phase 1
Rate of change of WQP influencing the formation of DBPs

Phase 2
Probabilistic model to detect the concentration of DBPs

Phase 3
Strategic placement of the sensing device

DBPFinder

H2OforAll

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Innovative Integrated Tools and Technologies to Protect and Treat Drinking Water from DBPs

LCA – New functional unit using water quality

1 Systematic literature review
(University of Leeds)

Unique actions

H2OforAll

2 Decision-support tool

End-user social study
(University of Leeds, DHV, Aguas de Coimbra, Universidade de Coimbra, Water Europe)

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Innovative Integrated Tools and Technologies to Protect and Treat Drinking Water from DBPs

- Recommendations on Prevention Measures for Safety Planning
- Policy Recommendations

H2OforAll

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Thank you!

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