Excerpt from Deliverable D6.3
Public summary - Midterm achievements

Public summary “Midterm achievements ”

Public excerpt from Deliverable D6.3, WP6

Project Number	**101081980**
Project Title	Climate-resilient management for safe disinfected and non-disinfected water supply systems
Project Acronym	SafeCREW
Project Duration	November 2022 – May 2026
Call identifier	HORIZON-CL6-2022-ZEROPOLLUTION-01
Due date of Deliverable	Month 24, 31.10.2024
Final version date	Month 24, 30.10.2024
Dissemination Level	PU (Public)
Deliverable No.	D6.3 (public exerpt)
Work Package	WP6
Task	T6.2
Lead Beneficiary	DVGW-TUHH
Contributing Beneficiaries	TUTECH
Report Author	Margarete Remmert-Rieper (TUTECH)
Reviewed by	Barbara Wendler (DVGW-TUHH), Mathias Ernst (DVGW-TUHH)
Approved by	Anissa Grieb (DVGW-TUHH)

This project has received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement No 101081980.

Part. No.	Participant organisation name	Short name
1 (Coordinator)	German Association for Gas and Water, local research branch at Hamburg University of Technology	DVGW-TUHH
2	Politecnico di Milano	POLIMI
3	Berlin Centre of Competence for Water	KWB
4	BioDetection Systems B.V.	BDS
5	Centre Tecnológic de Catalunya (EURECAT)	EUT
6	German Environment Agency	UBA
7	Helmholtz-Centre for Environmental Research	UFZ
8	Consorci Concessionari d'Aigües per als Ajuntaments i Industries de Tarragona	CAT
9	Tutech Innovation GmbH	TUTECH
10	Metropolitana Milanese SPA	MM
11	Multisensor systems Ltd.	MSS
12	The National University of Water and Environmental Engineering	NUWEE

This project has received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement No 101081980.

Abstract

This report summarises the midterm achievements during the first two years of the SafeCREW project. Current key results are presented followed by an outlook into the open tasks for the remaining 21 months. (task 6.2).

SafeCREW is funded by Horizon Europe to contribute to the safe production and distribution of drinking water. The project started in November 2022 and will run until April 2026. The first major milestone after the first project year of SafeCREW has been the development of a set of novel analytical methods for disinfection-by-products, natural organic matter and biotoxicity. These are now ready for application. First testing in the monitoring campaigns in case studies CS#2 and CS#3 started successfully and will be continued in the upcoming 21 months.

Another important step has been the successful onboarding of the new Ukrainian partner NUWEE since 1 May 2024 expanding the outreach beyond the EU.

In the upcoming period of the project, the monitoring and testing in the case studies will be completed and assessed. Application guidelines to facilitate the drinking water management under climate change conditions and policy recommendations will be developed and disseminated to stimulate the broad uptake of the solutions and to secure high drinking water quality management in Europe.

This project has received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement No 101081980.

Table of contents

Abbreviations

CS	Case study
DBP	Disinfection by-products
DoA	Description of Action
DW	Drinking water
DWD	Drinking Water Directive
DWDN	Drinking water distribution network
DWSS	Drinking water supply system
DWTP	Drinking water treatment plant
EC	European Commission
EO	Expected outcome
EU	European Union
FCM	Flow Cytometry
(G)AC	(Granular) Activated Carbon
GC-MS	Gas chromatography- mass spectrometry
HRT	Hydraulic retention time
MAR	Managed aquifer recharge
NOM	Natural Organic Matter
SFC	Supercritical Fluid Chromatography
SO	Strategic objective
THM	Trihalomethane
WG	Working group
WP	Work package
ZP4W	ZeroPollution4Water Cluster

This project has received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement No 101081980.

1. Introduction

SafeCREW is funded by Horizon Europe to contribute to the safe production and distribution of drinking water under climate change conditions. The project started in November 2022 and will run until April 2026. This report summarises the midterm achievements during the first project period.

SafeCREW will increase the preparedness of the EU water sector for challenges arising from climate change and will support the EU’s leading position in science-based policy making for drinking water consumer protection. Transferable tools will be provided to water utilities, national and EU regulators, researchers and enterprises. SafeCREW aims to support the novel EU Drinking Water Directive (EU DWD) by developing guidance for disinfected and non-disinfected drinking water supply systems.

Eleven research institutes and industry partners from Germany, Italy, the Netherlands, Spain and the UK worked on the development of analytical methods for disinfection-by-products and natural organic matter and toxicity assays in the first 21 months. These methods are now ready for application. In year 2, their testing started and the monitoring campaigns in the case studies are now in full motion. In May 2024, a Ukrainian water research institute hopped on the consortium and brought in a fourth case study.

Four specific objectives guide the SafeCREW approach:

- SO#1: Promote the use of a combined set of sampling and monitoring tools for a comprehensive water quality characterisation;
- SO#2: Support the implementation of novel drinking water treatment solutions to actively respond to identified threats;
- SO#3. Support the management of the drinking water distribution networks (DWDN) to avoid water quality deterioration up to final consumers; and
- SO#4. Transfer of solutions, tools and knowledge to end-users to boost their preparedness.

They follow the three main parts of drinking water supply systems (DWSS):

- the water source whose characteristics affect design and management of treatment trains and distribution;
- the drinking water treatment plant (DWTP) where, in case of applied disinfection, the main disinfection step is performed and adapted processes could be in place to reduce DBP precursors and minimise the DBP formation potential;
- and finally the drinking water distribution network (DWDN) which delivers water to consumers, possibly affecting produced water quality due to the interactions with additional boosting disinfection steps, pipe materials, biofilms, possible leakages, etc.

The key results achieved in the first 21 months are presented in section 2. Section 2 also includes an outlook into the open tasks for the remaining 21 months, followed by conclusions and outlook in section 3.

This project has received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement No 101081980.

2. Key Achievements

Following the four specific objectives, SafeCREW is organised in four technical work packages (WP). In the first 21 months, WP1 developed successfully analytical methods, sampling approaches and test protocols for a comprehensive water characterisation, focusing on natural organic matter (NOM) as DBP precursors, regulated DBPs like THM and specifically previously unknown highly polar DBPs and related toxicities. These methods have been used in WP2 to clarify technically relevant mechanisms in the DWSS and specifically support the development of novel water treatment technologies and strategies. The new methods have been applied in WP3 for full-scale monitoring of disinfection related challenges in the DWDNs of the case studies CS#2 in Milan and CS#3 in Tarragona. In WP4, they will support the development of guidelines and tools for the management of DWSS to minimise risks for consumers.

Key results achieved in the first period are:

Novel analytical methods and test protocols for a comprehensive water quality characterisation

- Two novel analytical methods for identifying previously unknown highly polar DBPs and advanced analytical approaches for characterising DBP precursors (NOM profiling) were developed and tested in operation. These methods provide the basis for better understanding the occurrence and formation of DBPs.
- A novel online chemical-free THM instrument (capable to identify the four regulated THMs in parallel) was developed, fully assembled and installed at CS#3. This offers a reliable and affordable online monitoring tool for DWSS to supply chemically and microbiologically safe water.
- New protocols for toxicity assessment of DBP mixtures based on in vitro toxicity profiling were established. This contributes to the improved risk assessment and management approaches for DWSS operators to fully adopt DWD articles 7-8.

Innovative drinking water treatment solutions and strategies to actively respond to identified threats

- Monitoring campaign in CS#1: Managed aquifer recharge (MAR) sites in Berlin are monitored and historical data were evaluated to better understand seasonal changes in the face of climate change. Microbial indicators (HNA/LNA ratio, TCC & virus log removal rates) for hygienically safe operation of bank filtration and/or artificial groundwater recharge were identified and the measurements with flow cytometry revealed microbial dynamics influenced by concurrent natural events and operational practices used for drinking water treatment.
- Electro-sorptive membranes, developed for the first time as a novel drinking water treatment technique, can effectively reduce DBP precursors. Applicability of commercial membrane adsorbers for reagent-less regeneration was confirmed, resulting in the highest DBP precursor removal in conductive membrane treatment.
- Cellulose-based nanostructured sponges (CNS) were synthesised and have preliminary shown to be effective in the removal of DBP precursors for the first time. Performances are comparable to activated carbon.
- A meta-model was developed for the first time to link water quality and toxicity to disinfection operating parameters in waterworks.

This project has received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement No 101081980.

Development towards management solutions for DWDNs under climate change

- Monitoring campaign in CS#2 Milan: Focus on the effect of pipe relining procedures on drinking water quality. Preliminary results showed a concentration of epichlorohydrin below the detection limit, but also the evidence that relining can result in a release of epichlorohydrin and bisphenol-A into the drinking water which might influence the DBP formation.
- Monitoring campaign in CS#3 Tarragona: Novel sulfonated DBPs have been analysed in a DWDN at Tarragona for the first time. However, compared to other DBPs the measured concentrations are relatively low (close to or below detection limit) and considered to be of little health risk relevance.
- Monitoring campaign in CS#3 Tarragona: Flow cytometry can be used for the checking of tank cleaning efficiency due to the quick assessment of microbiological concentration levels and has the potential to complement standard lab methods.
- Online monitoring of THM-DBPs show promising capabilities and will help to reduce high THM-DBP events in the future and to improve models.

Progress towards guidelines and tools for management and upgrade of DWSS to minimise risks for consumers

- Modelling climate change scenarios: Quantitative temporal trend evaluation and modelling of water quality parameters at two case studies demonstrated that anthropogenic influences at regional and local level have to be considered together with climate change impacts assessment. A publication on this topic will follow.
- For the development of the supporting tools for routine DWSS management, data collection from the monitoring campaigns and a preliminary soft sensor implementation are in progress.

Transfer of solutions and tools to the end users

- Active involvement in the internal and external activities and events of the ZP4W Cluster enhanced the outreach beyond SafeCREW: the first ZP4W Policy Brief and the first public draft of the ZP4W Case Study Inventory introduced the cluster, three jointly organised webinars trained more than 200 participants from water utilities, EC policy, local authorities and research, and three internal webinars fostered mutual learning.
- Nine networking events with German, Italian, Spanish and European authorities, utilities, and their associations and two focus groups resulted in the establishment of trusting relationships to the relevant stakeholders. Utilities and regulators have expressed their interest in SafeCREW's results, as there is a high transfer potential of methods and technologies for three different boundary conditions (river water as drinking water source in CS#3, quality impaired groundwater as drinking water source in CS#2, and sites in northern Europe with their currently often non-disinfected water supply systems (such as Hamburg and Berlin).

Open tasks for the second period

- Further development of a novel passive sampler for effective microbial monitoring for early warning.
- Development and evaluation of new test protocols for materials in contact with disinfectants for possible regulatory purposes.
- Further development of novel treatment processes for reducing DBP-precursor compounds and/or DBPs.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101081980.

- Evaluation of NOM behaviour in the full-scale systems with the novel analytical methods developed with the aim to understand and optimise the treatment types currently applied.
- Development of supporting tools for drinking water supply systems and strategies for safe drinking water distribution to avoid water quality deterioration up to final consumers based on the results of the monitoring campaigns in the case studies and model developments.
- Hydraulic modelling of CS#3 and modelling of chlorine decay in storage tanks to be used for the development of strategies and guidelines for risk-based water management in distribution networks.
- Development of an integrated risk assessment framework to guide future interventions that sustain safe drinking water supply (WP4) based on the novel analytical methods (WP1) and treatment technologies (WP2).
- Aggregation of results into application guidelines and policy recommendations to support the transfer of solutions, tools and knowledge to end-users.

.

Figure 1: Face-to-face discussion at SafeCREW project meetings, Copyright SafeCREW

This project has received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement No 101081980.

3. Conclusions and outlook

SafeCREW will ensure that drinking water continues to meet high-quality standards for all EU consumers in the face of the effects of climate change by supporting water utilities in climate-resilient management procedures. The project aims to support the implementation of the novel EU Drinking Water Directive (DWD) by generating advanced knowledge and developing tools and guidelines for disinfected and non-disinfected drinking water supply systems (DWSS).

This report presents the key achievements until June 2024 (month 21 of 42). To summarise the current progress of SafeCREW towards expected outcomes and impact, SafeCREW has already increased the EU scientific and technological knowledge base with a combined set of novel, innovative analytical methods, a new THM-sensor and water treatment developments. The methods have progressed towards a more comprehensive water quality characterisation and the identification of correlations between NOM-precursor compounds and DBP formation. This contributed to the robust knowledge of the occurrence, persistence and degradability of DBPs. The generated methods are now ready for application. The SafeCREW utilities already use the results from first measurement campaigns to enhance their knowledge base for early warning and DWSS management. The final aim of SafeCREW is the transfer of solutions, tools and knowledge to end-users to boost their preparedness for climate change effects. Work towards this aim builds on the SafeCREW analytical methods and tools, water technologies and treatment solutions and the monitoring campaigns in the DWDN. These results will be summarised, aggregated and further developed into guidance on measures to manage drinking water quality and evidence for policy-making, safety planning and implementation mainly during the last 21 months of the project. Targeted dissemination will promote the wide uptake of the guidelines, tools and recommendations.

This project has received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement No 101081980.

FOLLOW US

in safecrew-org

𝕏 safeCREW_org

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101081980.