



safe CREW

POLICY BRIEF

01 DECEMBER 2025

ADVANCING NAM/EBM FOR THE
ASSESSMENT OF DISINFECTION BY-
PRODUCTS AND COMPLEX CHEMICAL
MIXTURES IN DRINKING WATER



Non-animal-based / effect-based monitoring (NAM/EBM) has recently been introduced for surface water assessment¹, significantly enhancing the detection of harmful chemical mixtures. Within the EU project **SafeCREW**, we focus on **disinfection by-products (DBPs)** formed when disinfectants such as chlorine, chloramines, chlorine dioxide, or ozone react with organic or inorganic matter. Commonly known DBPs in drinking water include chlorate, chlorite, bromate, trihalomethanes (THMs), and haloacetic acids.

To assess the impact of these substances and their mixtures, we apply an extensive panel of human cell-based biological detection methods (e.g., **CALUX[®] assays**) to screen for key toxicity pathways, including cytotoxicity, genotoxicity, oxidative stress, endocrine activity, PAH-like effects, obesity-related mechanisms, and TTR–thyroid hormone displacement (PFAS-like toxicity)¹⁻⁵. These analyses are conducted at drinking water treatment plants (DWTPs) in **Milan, Italy**, and **Tarragona, Spain**.

Political Context and Key Challenges

The European Commission is committed to achieving a **Zero Pollution ambition for air, water, and soil by 2050**. The European Green Deal and the Chemicals Strategy for Sustainability aim to create a toxic-free environment, strengthen chemical safety, and support a sustainable circular economy^{2,3}.

However, **persistent (P), mobile (M), and toxic (T) substances** referred to as **PM(T) substances**, which include numerous DBPs present a substantial regulatory and environmental challenge. Their persistence, high mobility in aquatic environments, and potential toxicity enable them to bypass conventional water treatment processes. This poses risks to human health, aquatic ecosystems, and the EU's long-term sustainability goals.

Despite their relevance, **current EU water legislation such as the Water Framework Directive (WFD) and the Drinking Water Directive (DWD) does not yet comprehensively regulate PM(T) substances**, leading to significant protection gaps.

Why NAM/EBMs Are Needed Now

Most current (eco)toxicological assessments still rely heavily on **animal-based, single-substance testing**. These approaches are costly, slow, and misaligned with sustainability goals, societal expectations, and the EU's innovation agenda.

In contrast, **NAMs/EBMs** offer:

- **Holistic assessment of chemical mixtures**, not limited to known individual substances
- **Rapid, cost-effective, and animal-free testing methods**
- **Identification of both regulated and unregulated contaminants**, including unknowns
- **Improved competitiveness for EU SMEs and innovation ecosystems**

A particularly urgent area concerns **endocrine-disrupting chemicals (EDCs)**⁵. Despite substantial scientific advances and strengthened regulatory efforts over the past 15 years, only a limited number of substances have been regulated for their endocrine-disrupting properties. The single-substance, animal-intensive assessment approach is too slow to address the scale of the challenge: with more than 26,000 substances registered under REACH and an estimated 40,000 -60,000 chemicals in global use, **the current system cannot keep pace**. Health-related costs of EDC exposure in the EU alone were estimated at **€163 billion annually**.

Policy Recommendations

1. Promote the use of NAM/EBM-based bioanalysis

Encourage the integration of validated human-relevant in vitro methods to assess DBPs, DBP-related substances, water contact materials, and drinking water quality.

2. Increase dedicated Horizon Europe funding

Support research and innovation initiatives that advance the validation, harmonisation, and regulatory acceptance of NAM/EBMs for water quality assessment.

3. Strengthen training and capacity-building

Facilitate the transition from single-compound testing to mixture toxicity assessment through targeted training programmes and stakeholder outreach.

4. Foster next-generation, NAM-based regulatory frameworks

Promote the development and adoption of innovative regulatory concepts such as those described in **CEN Workshop Agreement 18201**, enabling faster and more reliable chemical safety assessment without animal testing.

5. Develop a European roadmap for a NAM/EBM-based regulatory system

Establish a clear, stepwise roadmap aligned with recent **EU Council conclusions** to modernise chemical risk assessment and achieve the Zero Pollution vision.

SafeCREW's Contribution

SafeCREW actively supports the implementation of the revised Drinking Water Directive by generating advanced scientific knowledge, tools, and guidelines for both disinfected and non-disinfected drinking water systems.

In 2023, SafeCREW and six sister projects founded the **ZeroPollution4Water Cluster** to:

- Safeguard groundwater from pollution and climate-related impacts,
- Ensure high drinking water quality through improved monitoring, innovative treatment solutions, and safe distribution systems,
- Promote monitoring tools for regulatory use and accelerate the transition toward a toxic-free and zero-pollution chemical risk governance system.

SafeCREW strongly endorses the uptake of NAM/EBMs in EU regulation and advocates for a forward-looking European roadmap to safeguard public health, support innovation, and ensure safe and sustainable drinking water for all.

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