

Anthropogenic Substances

A challenge to a resilient and healthy water supply for people and nature in 2030

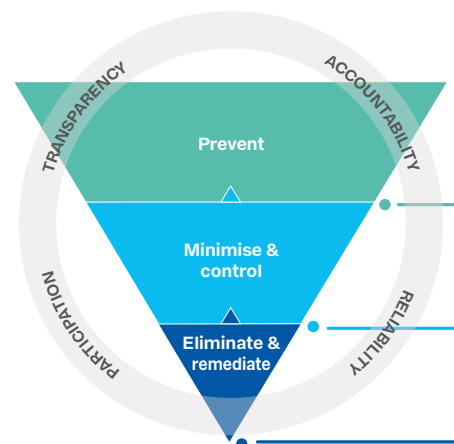
In our Strategic Agenda, we embrace the national and international ambitions for adaptation to global change, the energy transition and the sustainable use of natural resources. As part of these ambitions, Deltares is committed to contribute to a resilient and healthy water supply for people and nature in 2030. Anthropogenic substances are an essential component of this multi-faceted issue: plant protection products, pharmaceuticals, industrial organic substances, trace metals and technologically critical elements (TCEs), plastics in various dimensions (macro-, micro-, nano-) and engineered nano-materials.

Unintentional leakages of anthropogenic substances into the water system pose a threat to human health and biodiversity. Unless proper action is taken, over-exploitation of water resources due to population growth and the increasing frequency, duration and severity of drought events are expected to aggravate the issue. Deltares shares the vision and ambitions expressed by the European Commission in its 2021 “Towards Zero Pollution for Air, Water and Soil” Action Plan.

The zero-pollution ambition

Air, water and soil pollution is reduced to levels no longer considered harmful to health and natural ecosystems respecting the boundaries our planet can cope with, thus creating a toxic-free environment.

Deltares aims to contribute to this ambition and its targets for 2030 in particular. Following the EU Action Plan, the Zero Pollution hierarchy adopts the precautionary principle and the principles of preventive action, control at source and that the polluter should pay.



The zero pollution hierarchy as depicted in the EU Action Plan: Towards Zero Pollution

What is our contribution?

The past has shown that pollution prevention is only possible if pollution releases can be unambiguously and transparently quantified. How do manufacturing of materials, products and goods, their consumption and

service-life and their end-of-life as waste contribute to leakages of anthropogenic substances to the environment? Via which pathways do leaked substances reach surface waters and soils? How can circular economy reduce leakages of anthropogenic substances? What can be achieved by technological innovation and implementation of best available technologies?

This will contribute to more effective implementation and possibly improvement of existing policy frameworks (WFD, REACH, MSFD, UWWTD, etc.): substances authorization and regulation of uses, permitting of point sources, control of diffuse sources, environmental quality standards. By collecting and making available the necessary information, our society can be made aware of her pollution footprint, of the concept of living within the planetary (pollution) boundary, of pollution-labelling as a tool for consumers to take responsibility, etc.

If prevention is not (yet) feasible, a good quantitative understanding of anthropogenic substances leakages and their pathways to surface waters and soils helps to minimise and control the leakages. Where are the key leakages taking place? Point sources? Diffuse sources? Accidents? Illegal dumping? How do anthropogenic substances reach surface waters and soils? Which

Together with national and international knowledge partners, Deltares aims to provide these quantitative insights

mitigation options exist? How effective are they? Here we consider it helpful to focus on socio-economic functions of larger groups of chemicals or applications, on pathways to surface waters and soils, and not on individual chemicals (of which there are just too many). Deltares places the control of anthropogenic substances pollution in relation to other developments and challenges. There is a direct link to climate adaptation (green cities, water conservation in the urban environment, nature-based solutions) and to water management in a broad sense (artificial recharge, re-use of wastewater, independent water cycle). Here the use of smart and innovative monitoring tools and strategies (chemical analyses, screening-methods, sensors, effect-based methods) has an important role to play.

As a last option, Deltares can contribute to measures to locally eliminate and remediate anthropogenic substances pollution. Through site-scale and laboratory experiments, the feasibility and effectivity of treatment options can be investigated. Both Technical or Nature-based solutions are considered.

How do we achieve this?

Emission Inventories

A solid information base is indispensable for successful prevention and management of anthropogenic substances pollution. Deltares colleagues have been involved in the development of Technical Guidance on the Preparation of an Inventory of Emissions, Discharges and Losses of Priority and Priority Hazardous Substances (Common Implementation Strategy for the Water Framework Directive) from the very start. Deltares is responsible for the surface water part of the National Pollutant Release and Transfer Register, which is state-of-the-art globally. Deltares modellers develop innovative tools to support quantification of diffuse pollution sources. Thus, we contribute to raising awareness at all levels making sure our knowledge is accessible.



From Source to Sea

Deltares uses the 'Source to Sea' philosophy to provide a holistic approach that links sources of anthropogenic substances in river catchments to receiving soils and groundwater systems on the one hand and surface waters, sediments and coastal waters on the other hand. In groundwater, Deltares identifies the issue of the 'greying' which is the gradually increasing pollution with more substances to larger volumes of groundwater. In riverine systems, we investigate among other aspects the potential remobilization of pollutants from sediment to the water phase due to flooding (link to climate change), decommissioning of dams, dredging spoil management (interrupted river-sea sediment transport), and sludge depots. In coastal waters we assess flows of anthropogenic substances related to coastal interventions like dredging and the distribution of harbour sludge.

Anthropogenic substances pollution in an Integral context

Together with partners, we assess the effects of anthropogenic substances on water systems and human health. Loss of aquatic biodiversity can be evaluated by state-of-the-art mixture risk assessments accounting for bio-availability. Impacts of global socio-economic change on anthropogenic substances leakages or accumulation of anthropogenic substances are calculated, as is the interaction of anthropogenic substances pollution with



climate change and/or climate adaptation measures that affect diffuse emissions of anthropogenic substances and transport and fate processes. Also side effects of the energy transition (lithium, rare earth metals, technologically critical elements (TCEs)) are of interest. Together with partners we look for integral solutions and synergy for the management of ecosystems (measures for nature, water quality, climate, energy transition, agricultural transition).



Mathematical Modelling & Experimental facilities

Deltares believes in integrated or interoperable models as “containers” of acquired knowledge and system understanding. These can be applied for performing impact analysis in scenarios or small scale understanding of processes. We have the facilities to carry out experimental studies of attenuation and mobilization processes and experimental verification of models. With column experiments and/or sensing, we can perform experiments on lab-scale, site scale and field scale.

Dare to Share

The source code, input data and findings derived from models are shared with clients, partners and stakeholders freely, using the FAIR principles. Thus, we try to contribute to “Living Labs for green digital solutions and smart zero pollution (green and digital transformation” as formulated in the Zero Pollution Action Plan). Deltares’ BlueEarth and integrated platforms are just one way of exploring this, next to the development of digital twins of experiments and models, and the automatic generation of water system reports.

The impact we aim for

We are not the prime actor to make the chemical industry greener or to invent an alternative for plastic. Our role is generating consistent information to support awareness raising about the levels of anthropogenic substances pollution, their possible impact, the underlying causes and the ways to prevent or manage anthropogenic substances pollution. Thus, we can help making legislative instruments smarter and management processes more efficient. We strongly believe that we can learn from the past to improve the future. Using knowledge on long time existing issues such as coliform bacteria, BOD, nutrients, DDT, organotin, brominated flame retardants, we are better suited to prevent problems coming from plastics and emerging compounds like PFAS or any next problematic group of anthropogenic substances.

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Deltares is an independent institute for applied research in the field of water, subsurface and infrastructure. Throughout the world, we work on smart solutions, innovations and applications for people, environment and society. Deltares is based in Delft and Utrecht.

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