

Rethinking Chemical Pollution Through Sustainability Science

Dr. Edwin Routledge^{1,2,3}

¹PEAAR Ltd, London, UK

²Brunel University London, Uxbridge, Middlesex, UK

³Blekinge Institute of Technology, Karlskrona, Sweden

Extended Abstract

Modern society benefits greatly from many chemicals, from pharmaceuticals and pesticides to plasticizers, surfactants, and personal care products. Yet their production, use, release, and transformation are also in many cases placing increasing pressure on ecosystems, water resources, soils, wildlife, and human health. Research on endocrine-disrupting chemicals and emerging contaminants has shown that even low-dose and mixture exposures can produce biologically significant effects, challenging regulatory systems designed largely around individual substances and downstream control.

This plenary address argues that sustainability science, and in particular the Framework for Strategic Sustainable Development, offers a powerful way to reframe chemical pollution as a systems challenge. Rather than asking only whether individual chemicals meet current safety thresholds, a sustainability perspective asks whether society is systematically increasing concentrations of biologically active substances in nature, and how chemical systems can be redesigned to avoid that outcome.

Drawing on examples from endocrine-disruption research, including oestrogenic activity in sewage effluents, mixture effects in river catchments, pharmaceutical impacts on aquatic organisms, and microplastics from consumer products, the talk will explore how toxicological evidence can be translated into upstream action. Systems thinking, combined with tools such as life-cycle assessment, circular-economy principles, substitution, and sustainability metrics can all help shift chemical management from detection and remediation toward prevention, safer design, and more coherent policy.

The central message is that toxicology reveals the biological consequences of unsustainable chemical flows, while sustainability science provides a strategic pathway for redesigning those flows. Building a safer chemical future will require integrated, system-wide approaches that preserve the benefits of chemicals while sharply reducing their environmental and health burdens.