Setting the scene: impact of micropollutants on aquatic environment and the European regulatory advances

Delahaye, 2024

Mikhail Durkin, CCB

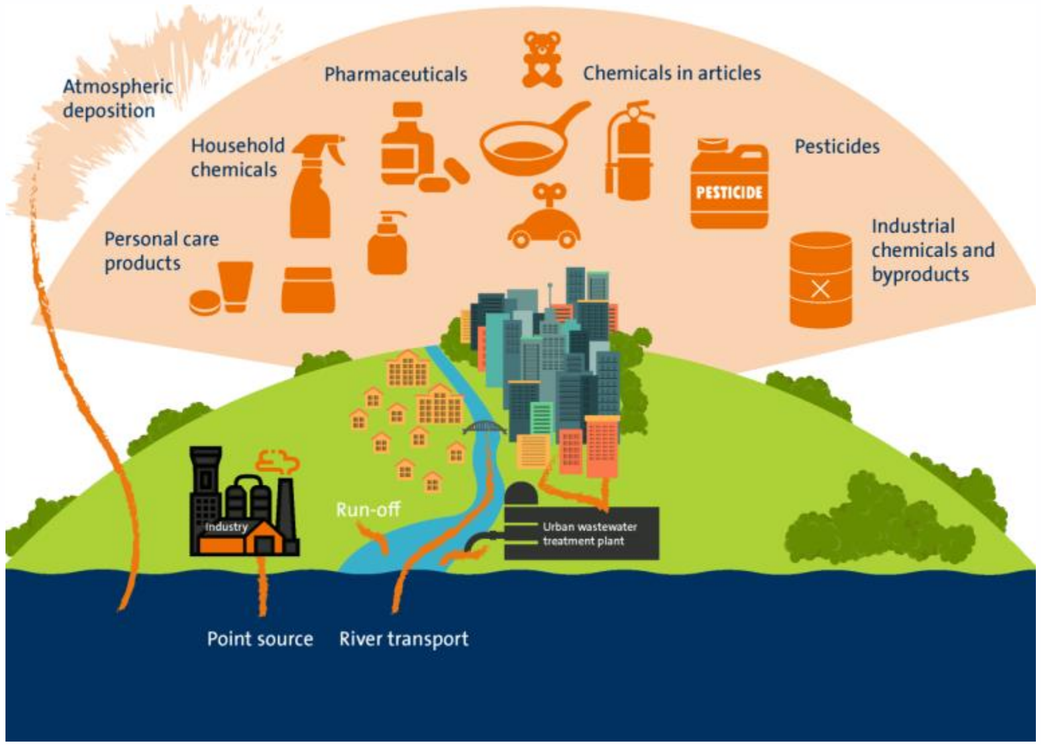
UBC TALKS webinar
Introducing new era of toxic-free water cycle
Tuesday 25 March 2025

Coalition Clean Baltic
FOR PROTECTION OF THE BALTIC SEA ENVIRONMENT

Micropollutants (MPs)

- can be defined as **anthropogenic chemicals** that occur in the (aquatic) environment well above a (potential) natural background level
- recognized and characterized due to their presence in **trace amounts** (from µg/L to less than ng/L) among different environmental matrices and living organisms.

💊 **Pharmaceutical residues:** from medical treatments.
🚜 **Pesticides and metabolites:** used in agriculture to protect crops.
🛁 **Personal care products:** such as shampoos, deodorants, and cosmetics.
🏭 **Industrial chemicals:** discharged during manufacturing processes.
🌊 **Microplastics:** from the degradation of plastics and synthetic fibers from clothing and tires
⚙️ **Heavy metals:** such as cadmium, lead, and arsenic

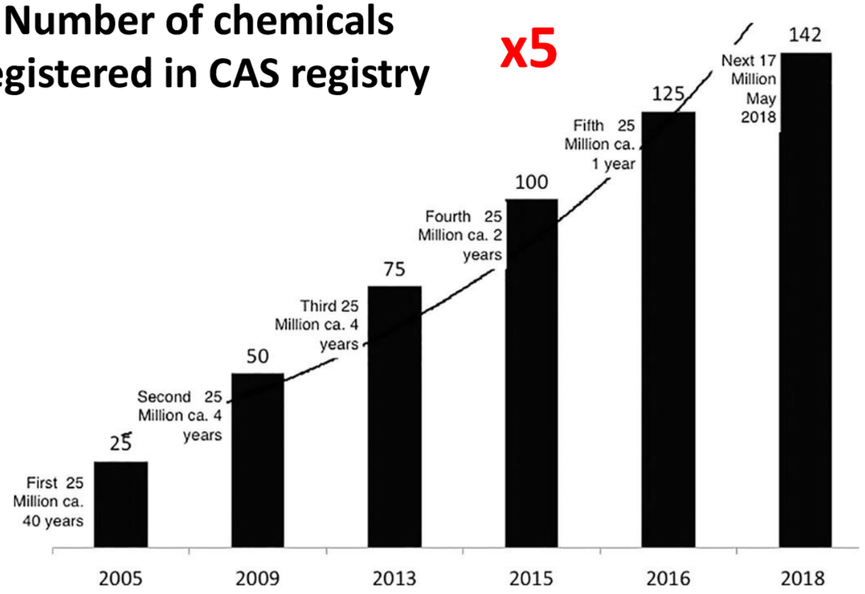


https://www.su.se/stockholm-university-baltic-sea-centre/policy-analysis/policy-briefs-and-fact-sheets/call-for-better-management-of-micropollutants-in-wastewater-1.590634

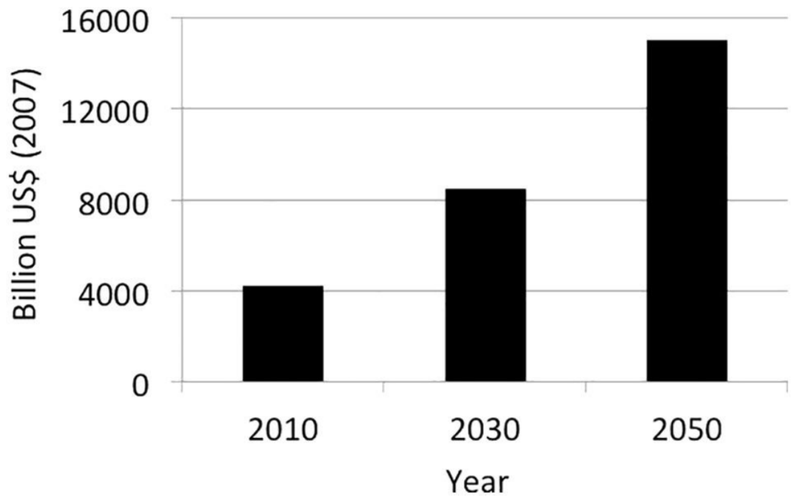
Micropollutant emissions follows growth

Growth('GDP') = Production(goods&services) + Waste(emissions&pollutions)

Number of chemicals registered in CAS registry **x5**

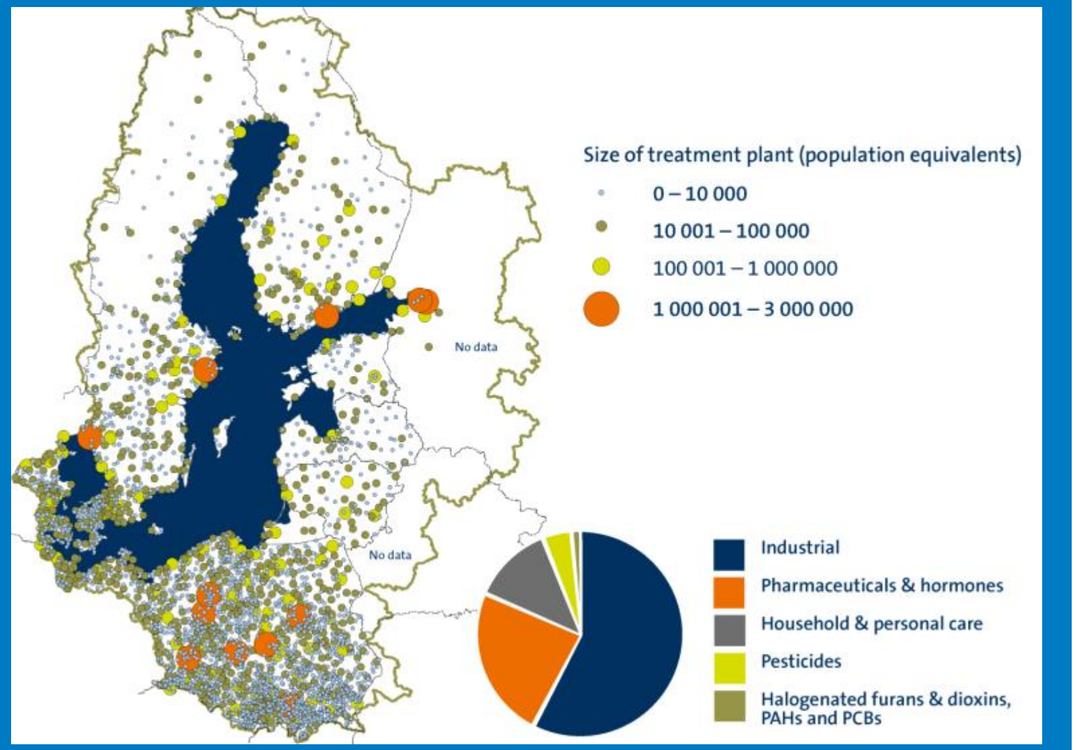


Sales value of chemicals **x3**



Kümmerer et. al., Stoten 2019; www.cas.org; OECD, 2012

MP: Scale of a problem



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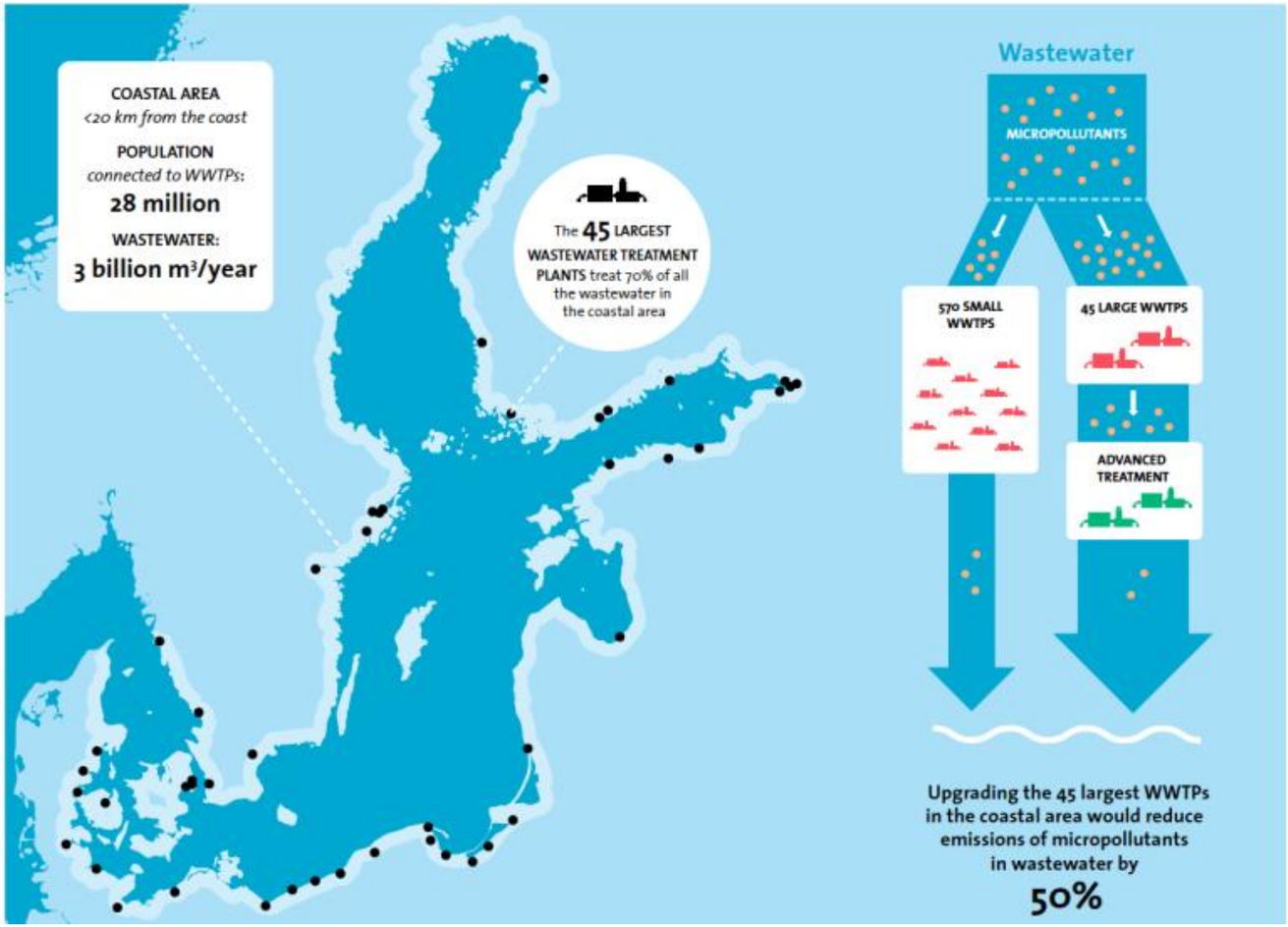


https://www.su.se/stockholm-university-baltic-sea-centre/web-magazine-baltic-eye/hazardous-substances/pharmaceuticals-can-be-stopped-in-advanced-waste-water-treatment-plants-1.613914

Treatment Solutions for Removing MPs from Wastewater

- Activated Carbon Adsorption
- Ozonation
- Reverse osmosis
- Nanofiltration

Impacts of Micropollutants on the Environment and Health

Even at low concentrations, micropollutants can have significant effects on the environment and human health. Impacts include:

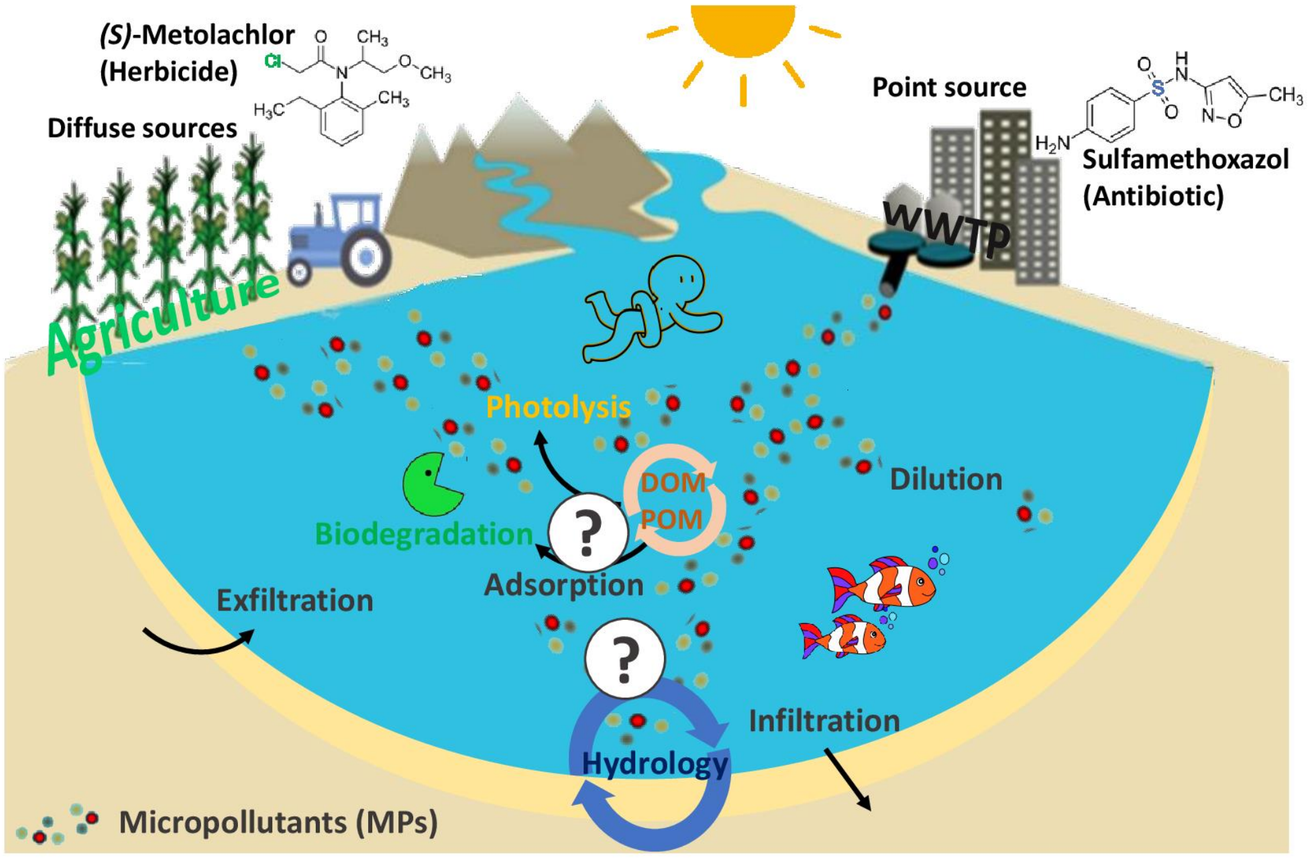
Endocrine disruption: Many micropollutants act as endocrine disruptors, affecting reproduction and development in aquatic organisms.

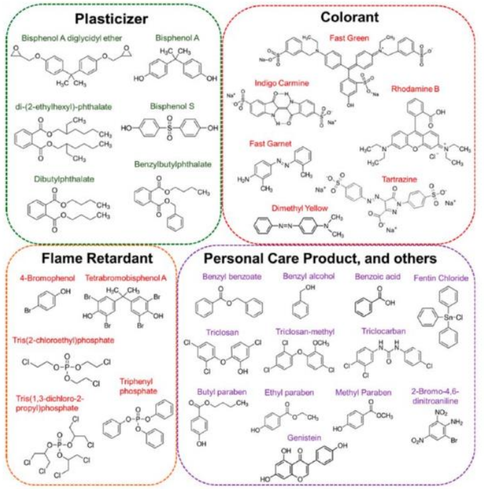
Bioaccumulation: Some micropollutants accumulate in the food chain, endangering aquatic wildlife and predators, including humans.

Acute and chronic toxicity: Toxic effects can be immediate or long-term, causing malformations, diseases, and mortality in sensitive species.

https://youtu.be/4C2u2ySIP3c

Interdisciplinarity research on micropollutants in the environment

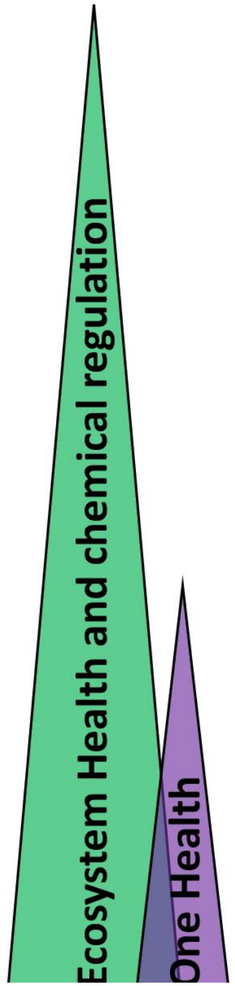




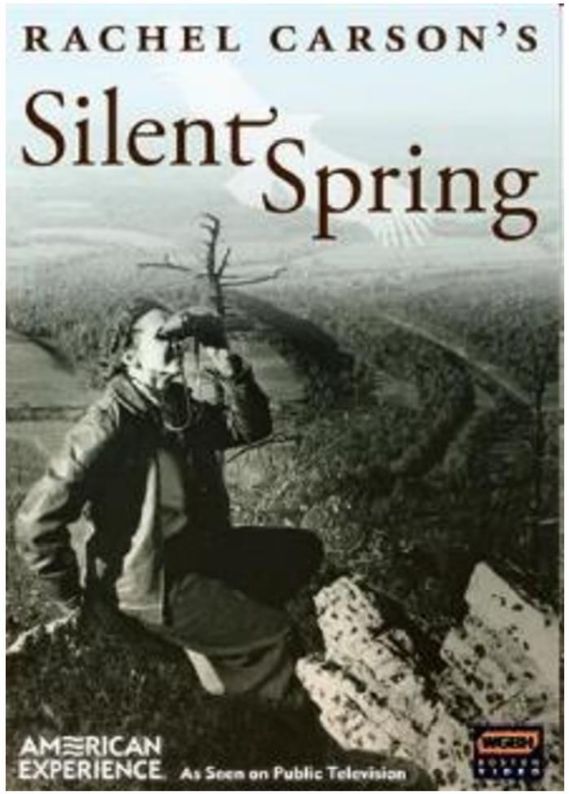
- ***Fate* and *transformation products*?**
- ***Effects on ecosystems*: cocktail effect?**
- ***Effects on human health*: cocktail effect?**
- ***Regulatory framework*: risk assessement and priority compounds?**

Micropollutants in the environment from interdisciplinary environmental research to 'One Health' actions?

From Silent Spring to ‘One Health’ including chemical contaminants



<1930	Industrial chemical production
1962	**Silent Spring (Rachel Carlson)**
1970s	Pesticide regulation starting (DDT)
1973	Chemical products resultation (Japan)
1976	Toxic Substance Control Act (US)
1981	European legislation (EU)
2004	Pesistent Organic Pollutants (Stockholm Convention)
2007	**REACH European legislation**
2011	EU ‘OneHealth’ action plan
2015	WHO Global Action Plan on AMR
202X?	**‘OneHealth’ including micropollutant impacts and socio-ecosystem trajectories?**



European Regulation on Micropollutants

European policy towards micropollutants in surface and groundwater is based on the principles of **'Control-at-Source'** and **'Polluter-Pays'**. Key regulatory frameworks include:

- **Water Framework Directive (WFD):** Sets standards for water quality and mandates member states to protect and improve the quality of water bodies.
- **REACH (Registration, Evaluation, Authorisation, and Restriction of Chemicals):** Controls the use and release of chemical substances.
- **Directive on Priority Substances:** Lists substances that must be monitored and controlled in surface waters, including certain micropollutants.

New Urban Wastewater Treatment Directive

Directive (EU) 2024/3019 of the European Parliament and of the Council of 27 November 2024 concerning urban wastewater treatment (recast) (Text with EEA relevance)

https://eur-lex.europa.eu/eli/dir/2024/3019/oj

The new EU Wastewater Treatment Directive aims to further improve the quality of treated wastewater and reduce the environmental impact of wastewater discharges. Key aspects include:

- **Advanced Treatment Requirements:** The directive mandates the implementation of advanced treatment technologies to remove micropollutants from wastewater, especially in large urban areas. The new directive requires the removal of 80% of MPs among a list of 13 substances by 2045 by quaternary treatment (mandatory – WWTPs over 150 K PE)

- **Producers of pharmaceuticals and cosmetics** – the main source of micropollutants in urban wastewater – will need to contribute a **minimum of 80%** of the additional costs for the quaternary treatment, through an **extended producer responsibility (EPR) scheme** and in accordance with the 'polluter pays' principle

- **Monitoring and Reporting:** Enhanced monitoring and reporting requirements for wastewater treatment plants to ensure compliance with stricter effluent standards

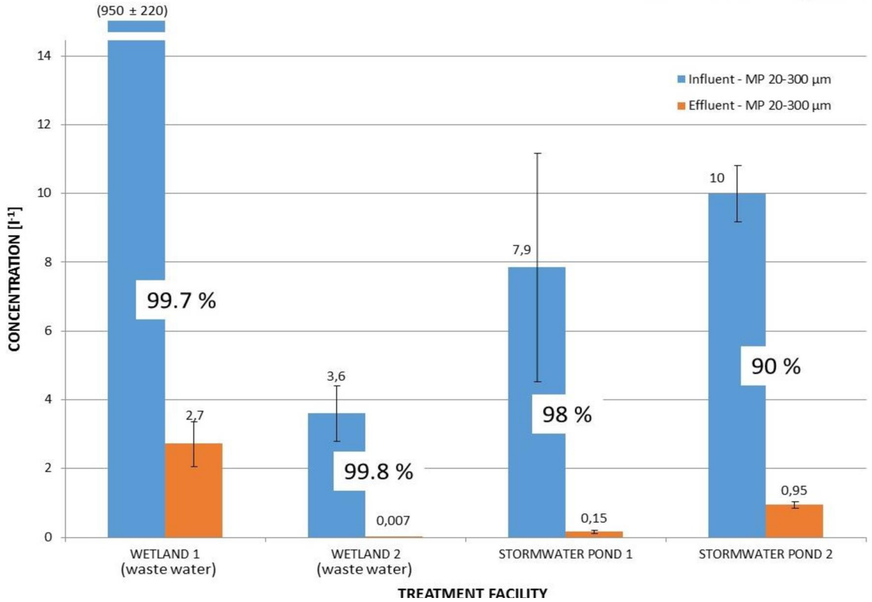
Category 1 (substances that can be very easily treated): Amisulprid, Carbamazepine, Citalopram, Clarithromycin, Diclofenac, Hydrochlorothiazide, Metoprolol, Venlafaxine

Category 2 (substances that can be easily disposed of): Benzotriazole, Candesartan, Irbesartan, mixture of 4-methylbenzotriazole and 5-methylbenzotriazole

Constructed wetlands - a potential win, win, win solution

Mikhail Durkin, Coalition Clean Baltic

HELCOM



[Constructed wetlands a concrete way to remove micro plastics, CCB, 2016]

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[“Constructed Wetlands Save Frogs, Birds Threatened With Extinction”, Science News Jan. 21, 2014]

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Summary

- **5 wetlands** (CW), all connected to MWWTPs, **5,000-90,000 p.e**.
- **19 of 24** investigated **APIs** were found in CW
- **Highest** concentrations: **naproxen, ibuprofen and diclofenac, furosemide, metoprolol, oxazepam**
- **47% APIs** reduced **20-80%**; **47% APIs > 80%**
- **Diclofenac, furosemide, and naproxen** reduced **74–100%.**

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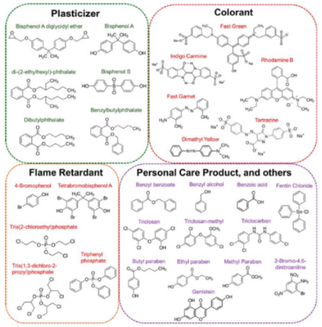
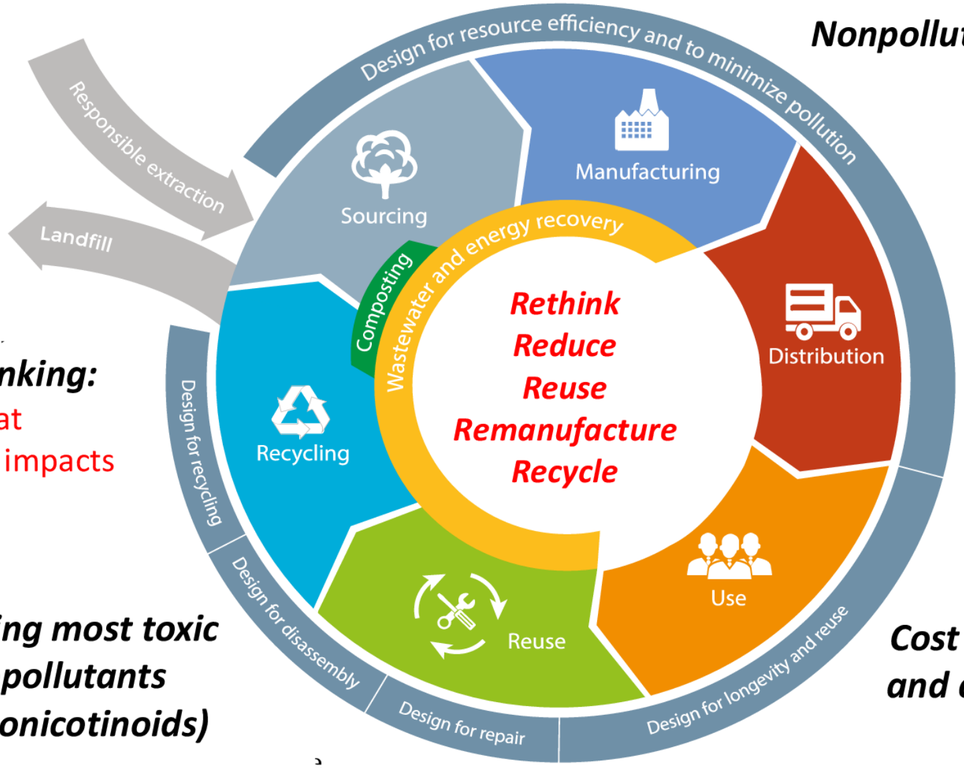
Prevention at source : the interdisciplinary grand challenge

Toward full circular economy designed to prevent waste and micropollution from the outset



***Design** based on*
***real social needs** and life-cycle thinking:*
Pollution prevention considered at
every design stage to minimize negative impacts



Nonpolluting components and processes

Including circular economy in regulatory frameworks

Eliminating most toxic micropollutants (e.g., neonicotinoids)

Cost estimates of micropollution and communication (e.g., labels)

***Incremental chemical or technical innovations** postponing challenges to the future are **dystopic solutions** (e.g. PFAS)*

Micropollutants in the environment from interdisciplinary environmental research to 'One Health' actions?

Do you have any questions?

Feel free to reach out!

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