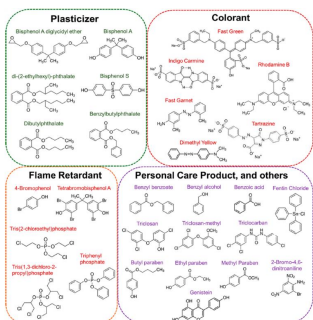
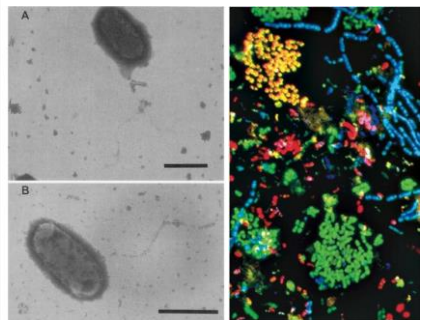
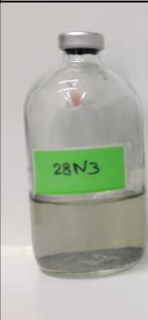




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Micropollutants in the environment

from interdisciplinary environmental research to 'One Health' actions?

Gwenaël Imfeld

March 31st, 2023

Symposium transdisciplinary research for a healthy planet



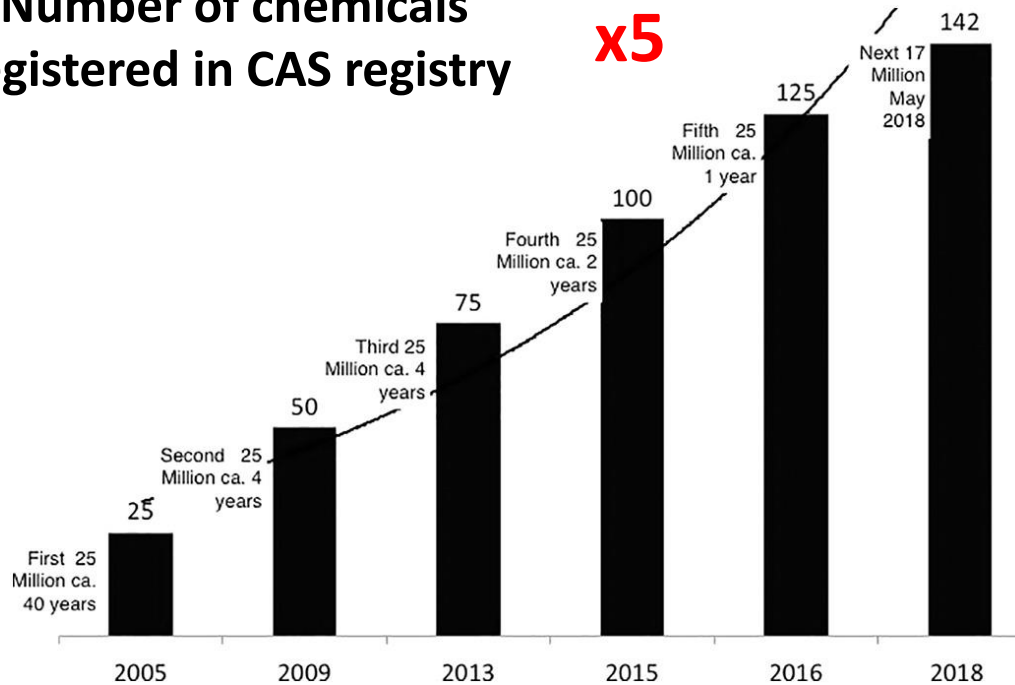

Institut Terre & Environnement
 de **Strasbourg** | ITES | UMR 7063
 de l'Université de Strasbourg &  & 

Micropollutant emissions follows growth

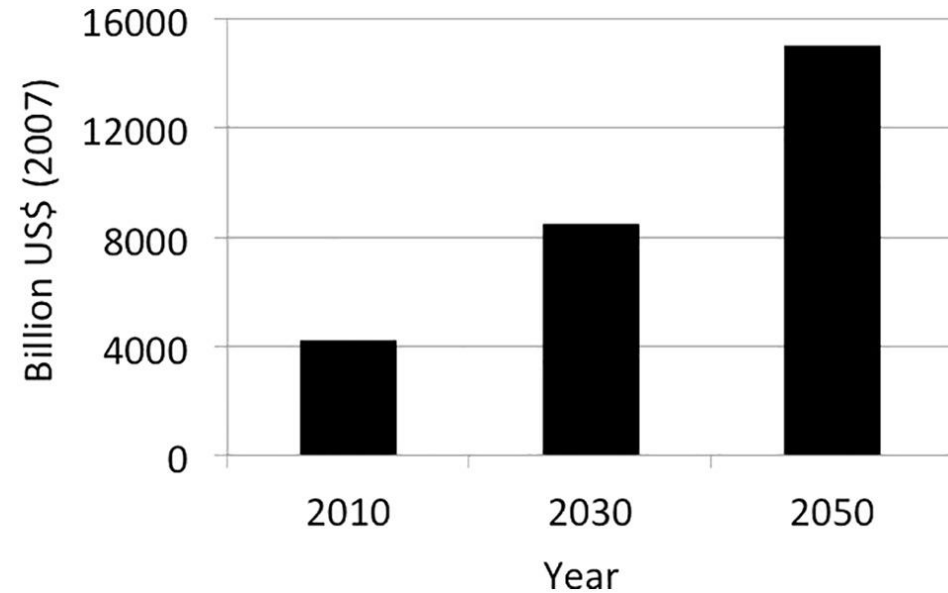
$$\text{Growth('GDP')} = \text{Production(goods\&services)} + \text{Waste(emissions\&pollutions)}$$

Number of chemicals registered in CAS registry

x5

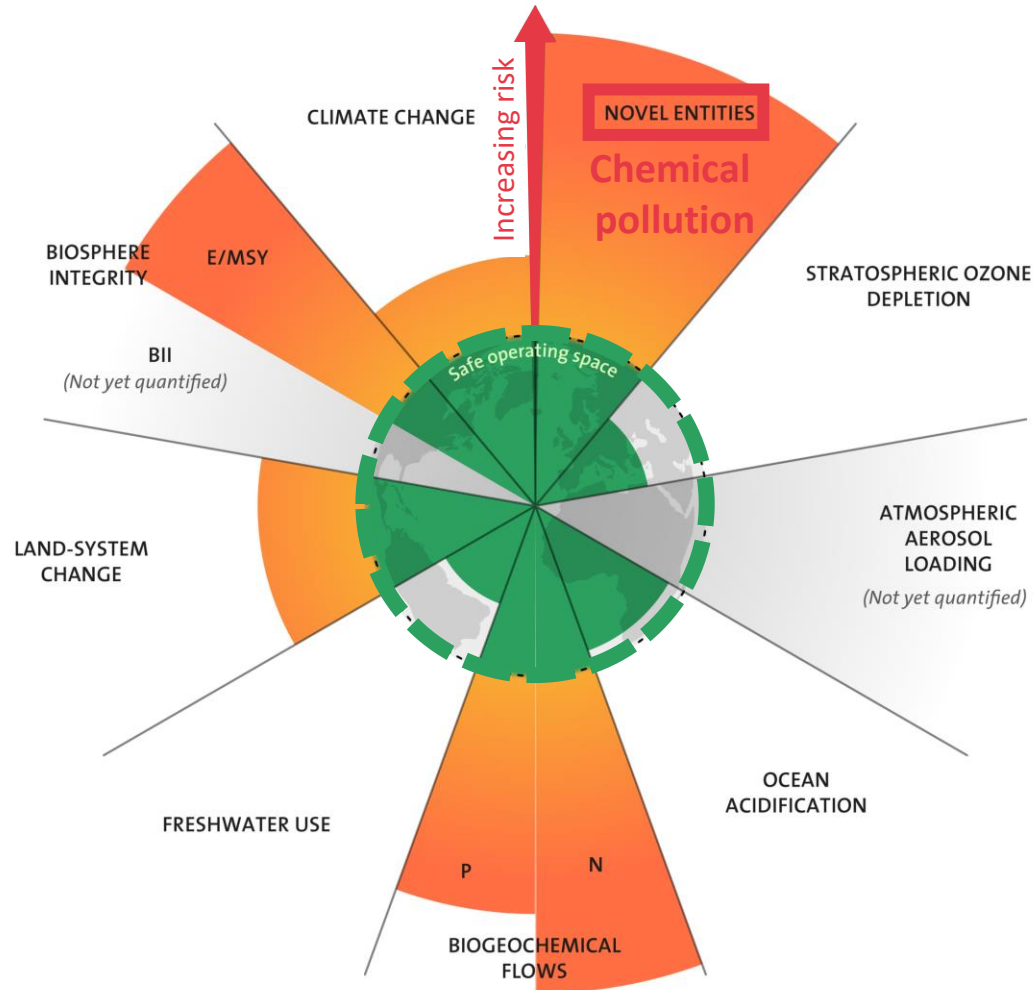


Sales value of chemicals x3



Chemical pollution causes about 9 million premature deaths yearly

'Novel entities' : outside the safe operating space of the planetary boundary



- Micropollutants and their TP are mostly 'novel entities'
- Characteristics: **persistence**, **mobility** and **negative** impact
- Planetary boundary transgressed based on:

➤ **Increasing rate: production and releases**



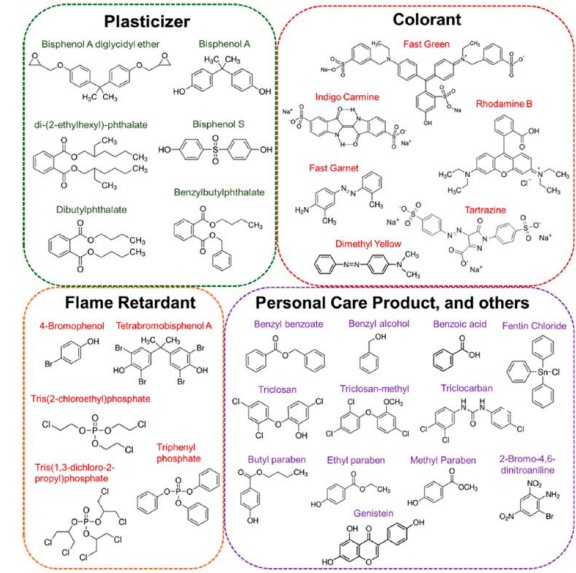
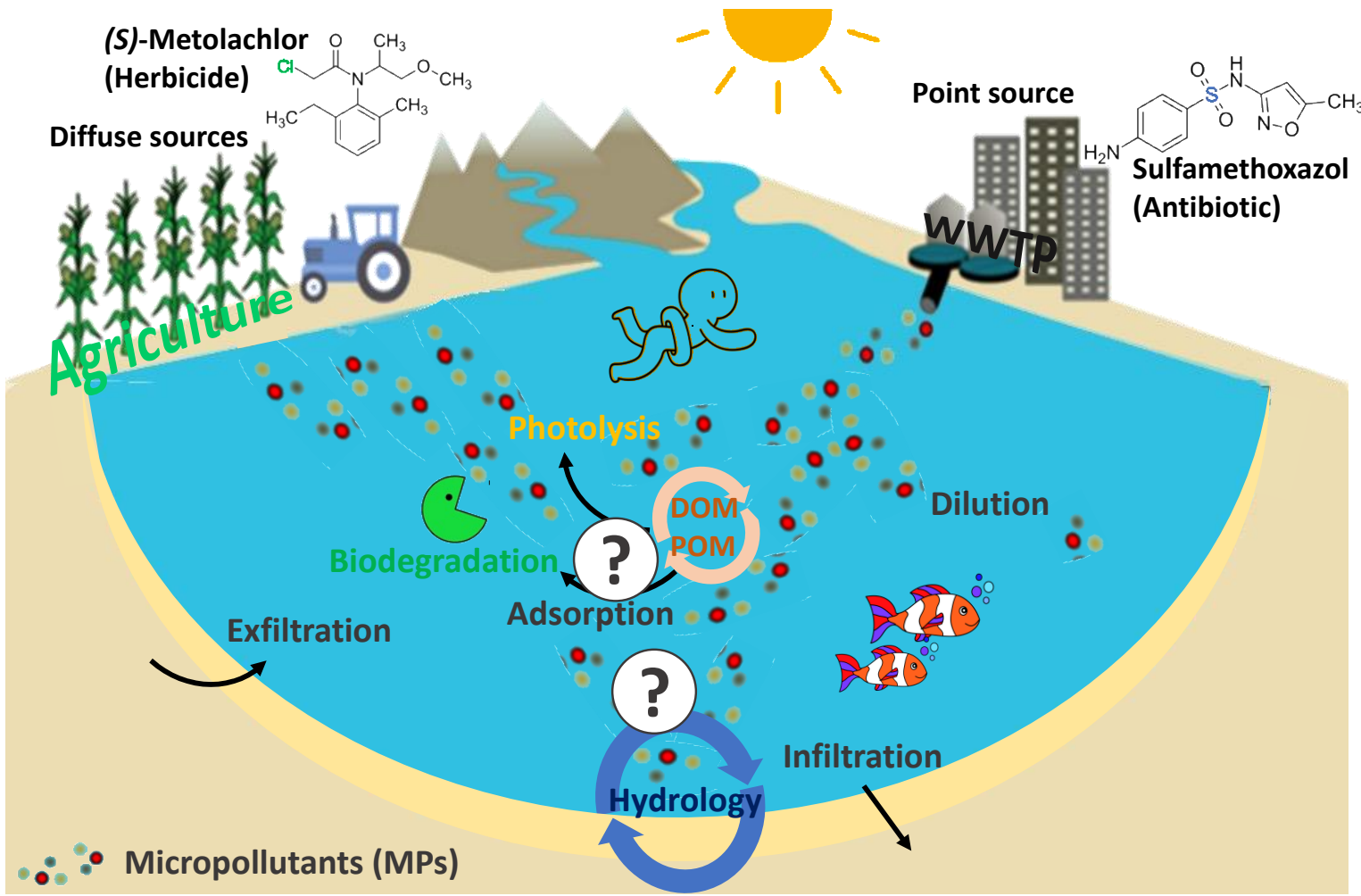
➤ **Higher release: novel entities with diverse risk potentials**



➤ **Exceed ability: conduct safety assessments and monitoring**



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 assesment and priority compounds?**

Micropollutant fate and formation of transformation products (1/2)?

Biocides: found in huge amount in daily-life materials

Example of building facades

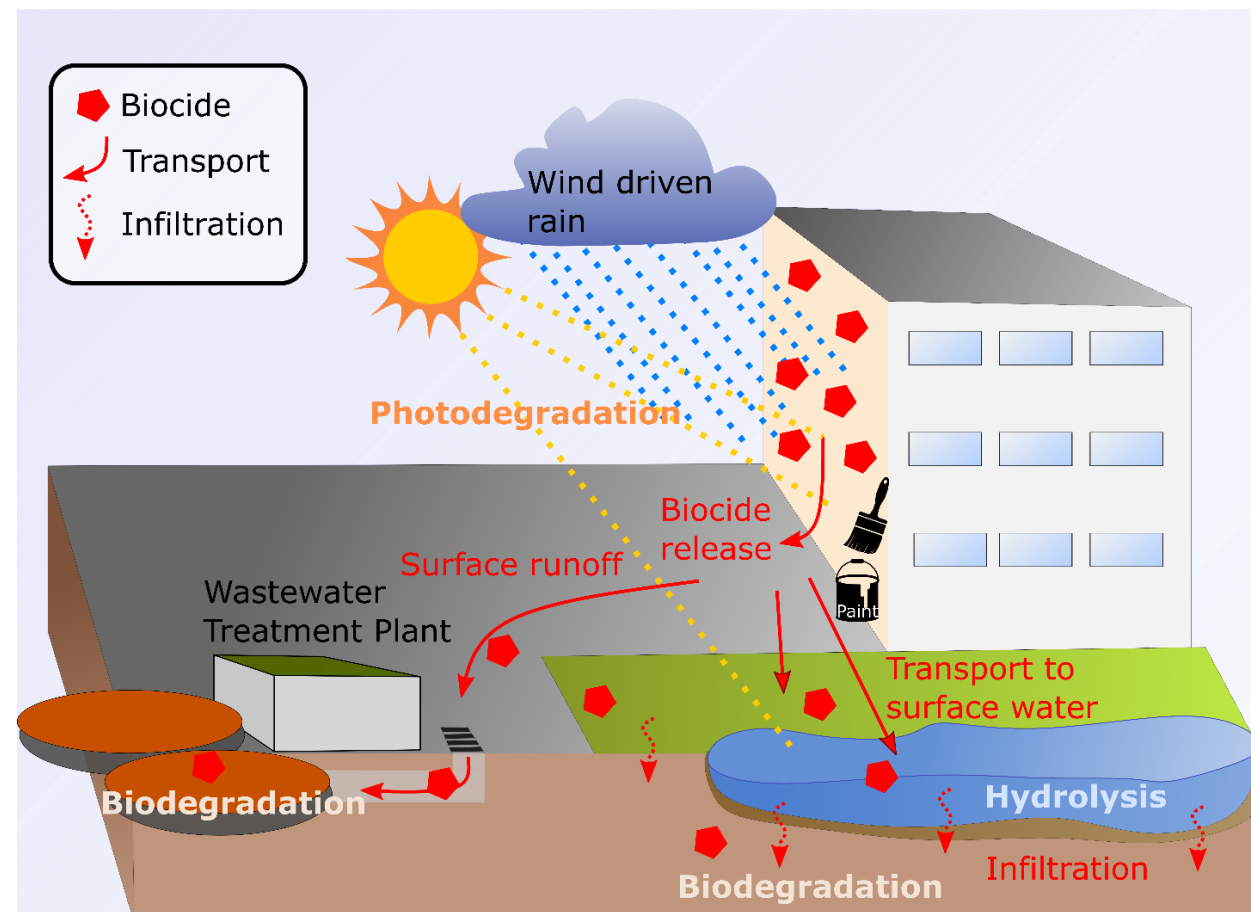


terbutryne (CAS 886-50-0), octhilineone (CAS 2653)

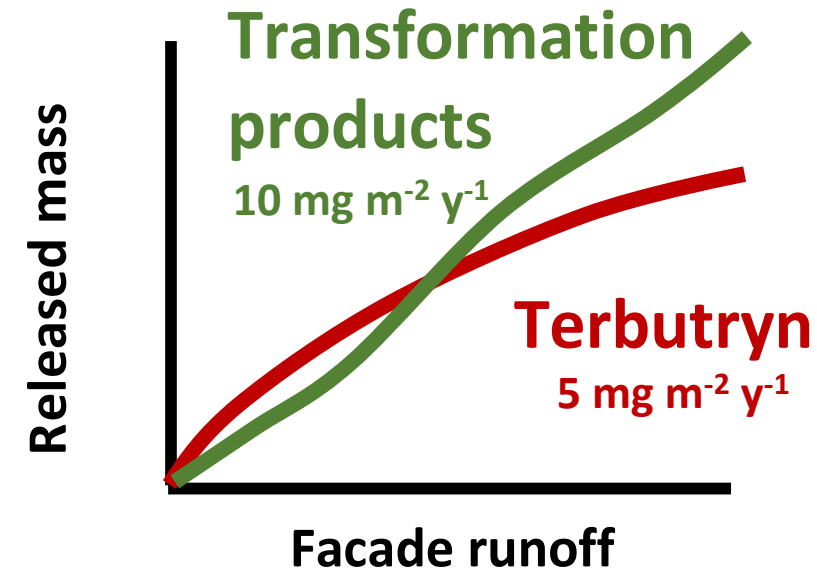
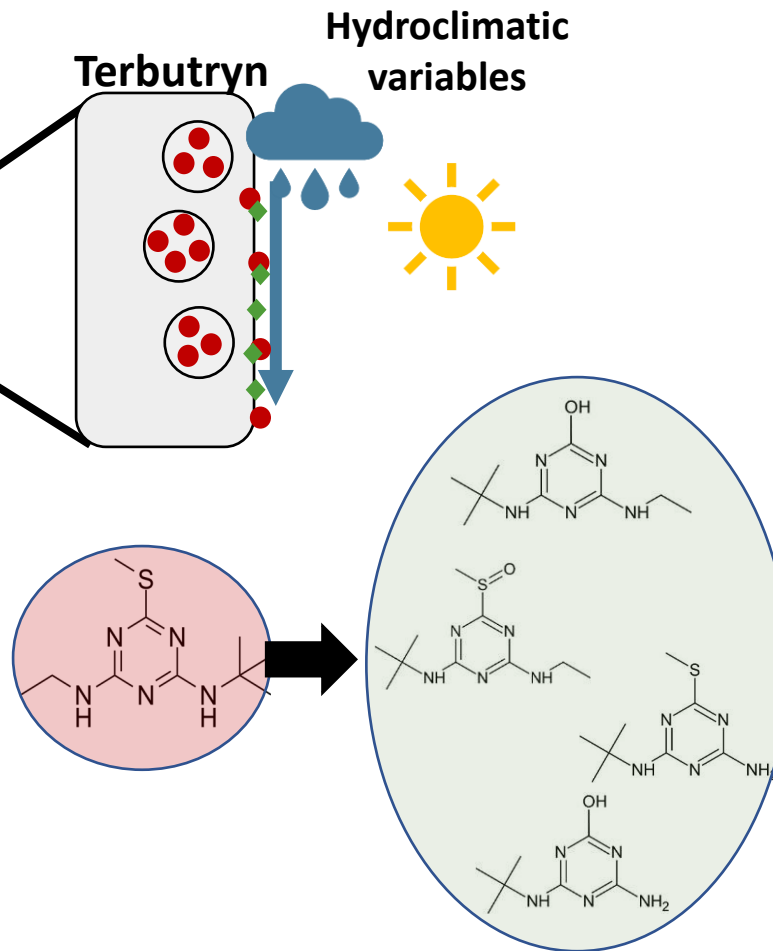
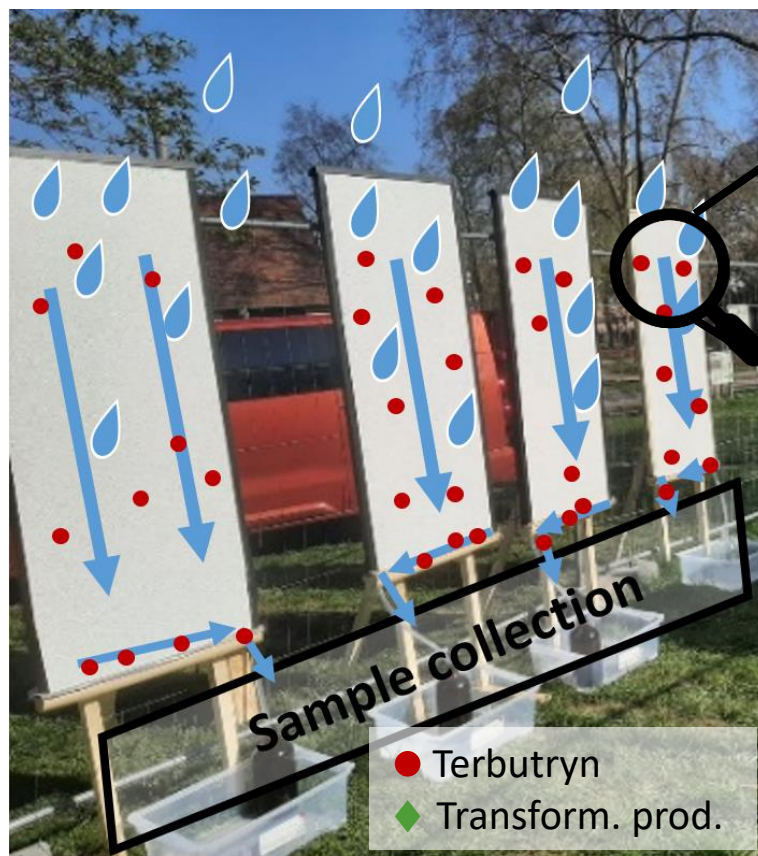


0.1 to 0.5 % biocide

- **Consumers, city services and professionals: not aware**
- **Alternatives: mineral paints, sustainable buildings, etc.**



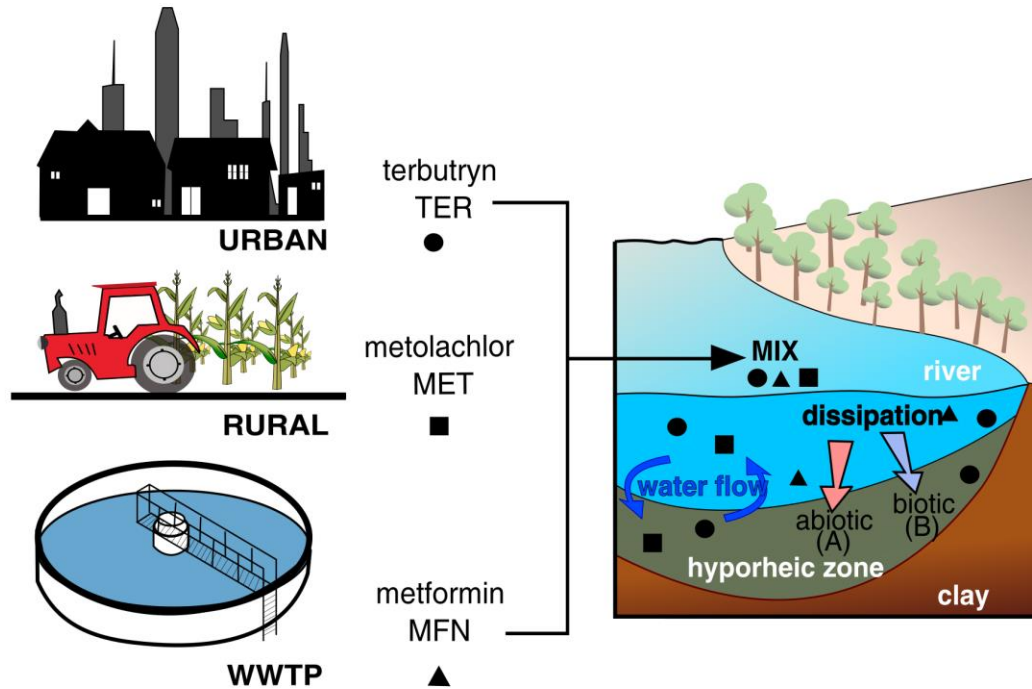
Micropollutant fate and formation of transformation products (2/2)?



*Unknown, potentially toxic transformation products: constantly released in higher amount than the **parent biocide!***



Micropollutant impact on ecosystems: a cocktail effect?

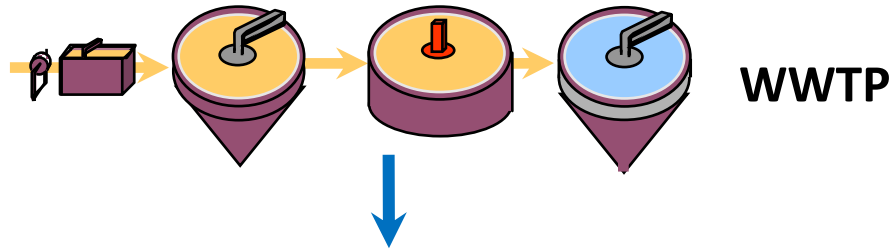


MICROPOLLUTANT CONVERGENCE AT THE SEDIMENT WATER INTERFACE

Cocktail effect to be accounted for when evaluating risks of micropollutants



Micropollutant impact on human health: a cocktail effect?



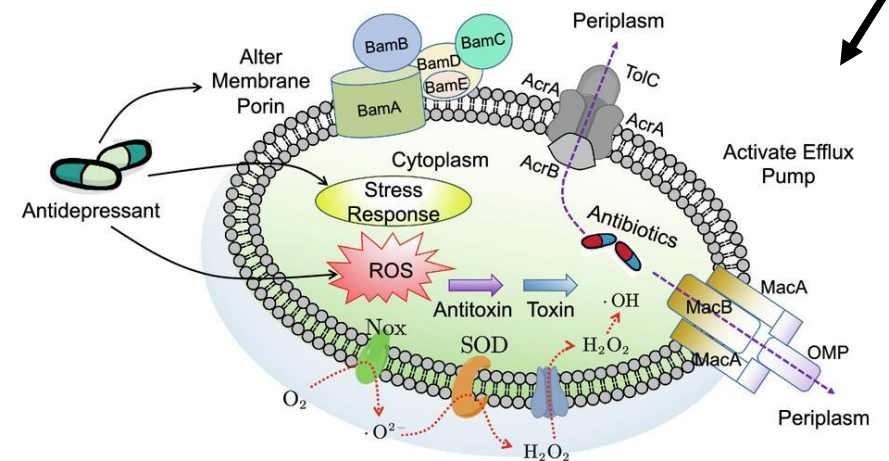
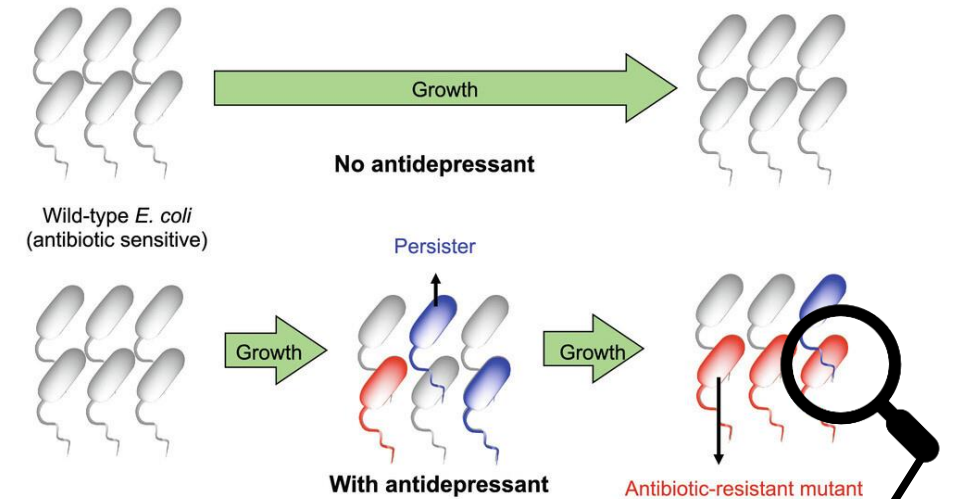
Antidepressants X Antibiotics



- *Reactive oxygen species*
- *Stress signature responses*
- *Stimulation of efflux pump*

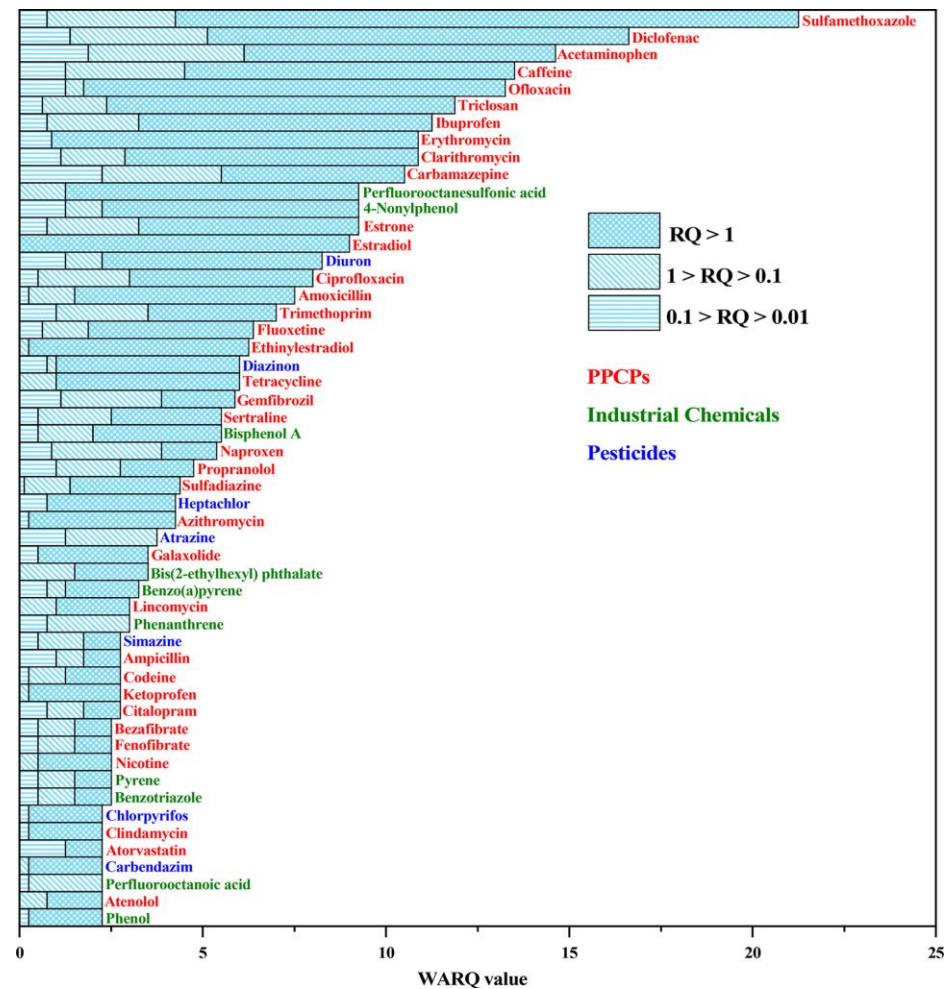
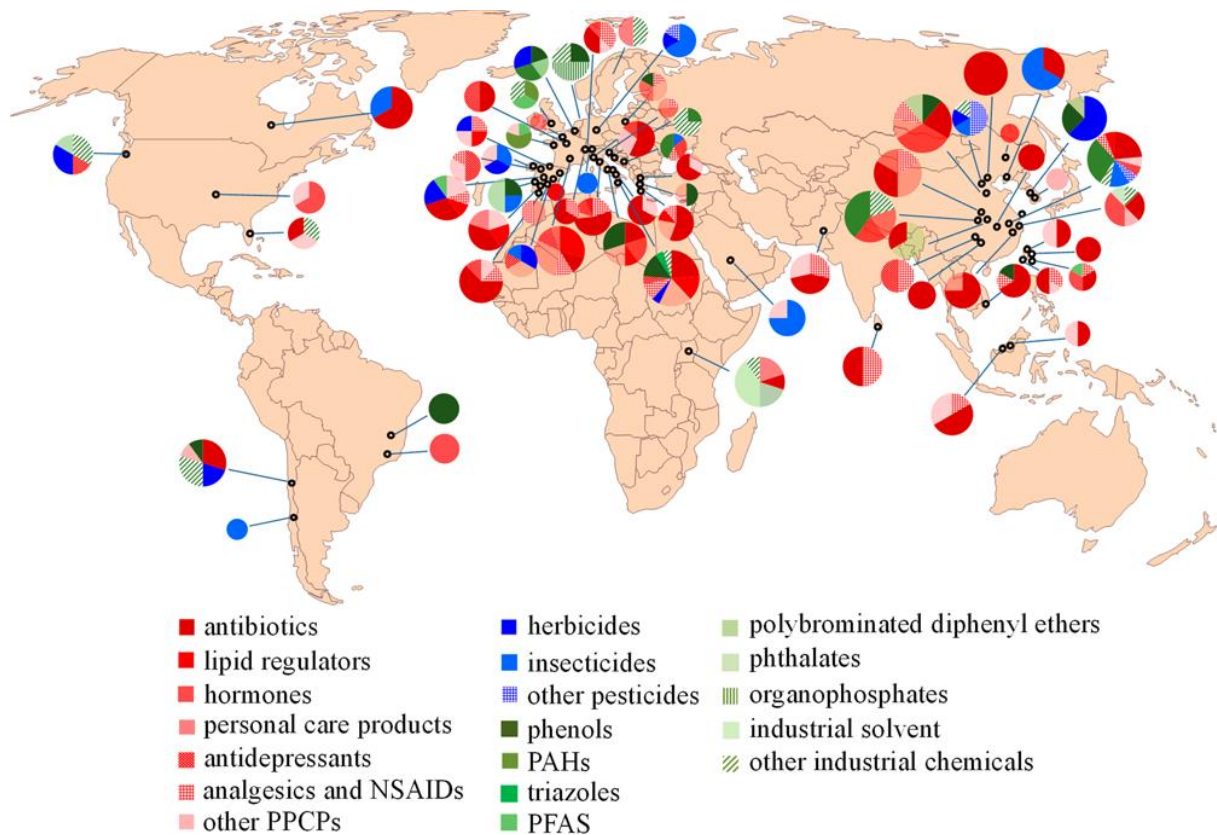
Increased antibiotic resistance and persistence

Antidepressants induce antibiotic resistance and persistence



Improving regulatory framework: risk assessment and priority compounds?

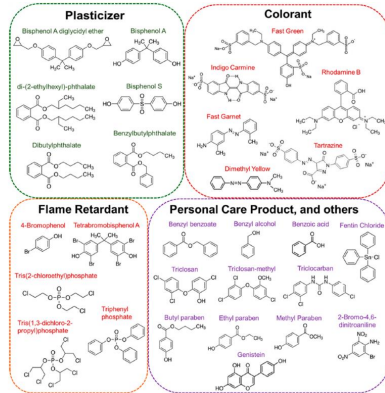
Micropollutant subgroups with highest priority levels (risk quotient)



Integrated approaches: risk intensity and frequency of micropollutants for priority determination

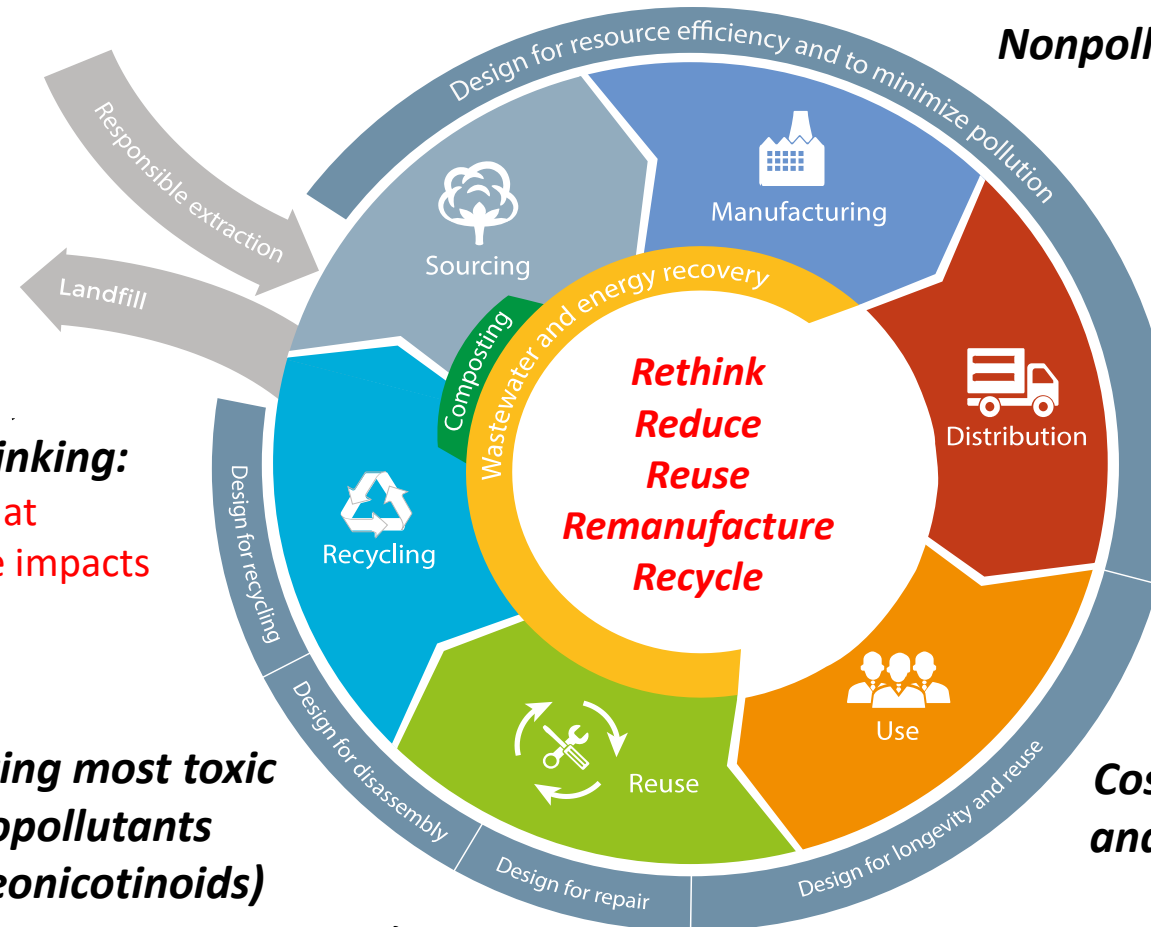
Prevention at source : the interdisciplinary grand challenge

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

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



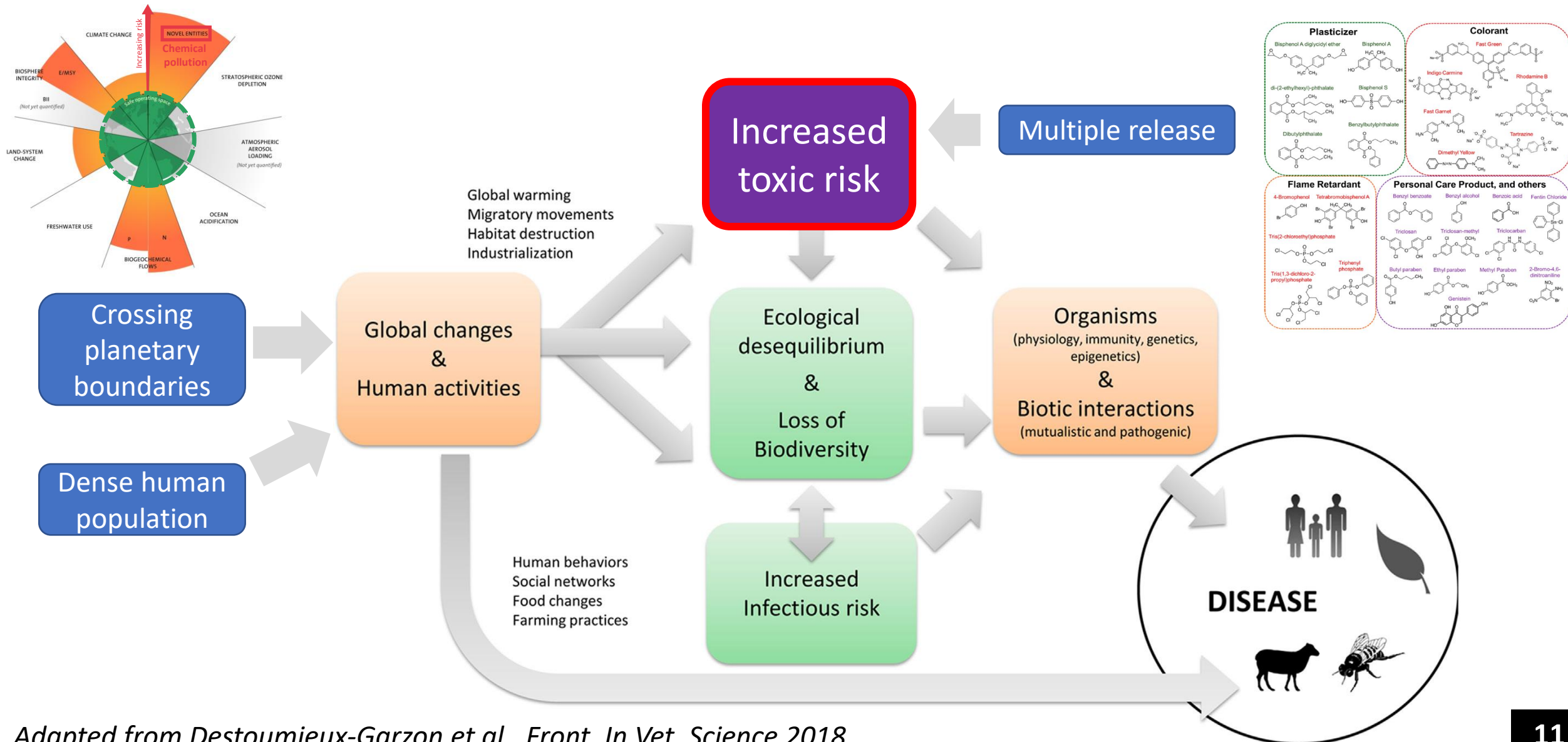
Nonpolluting components and processes

Including circular economy in regulatory frameworks

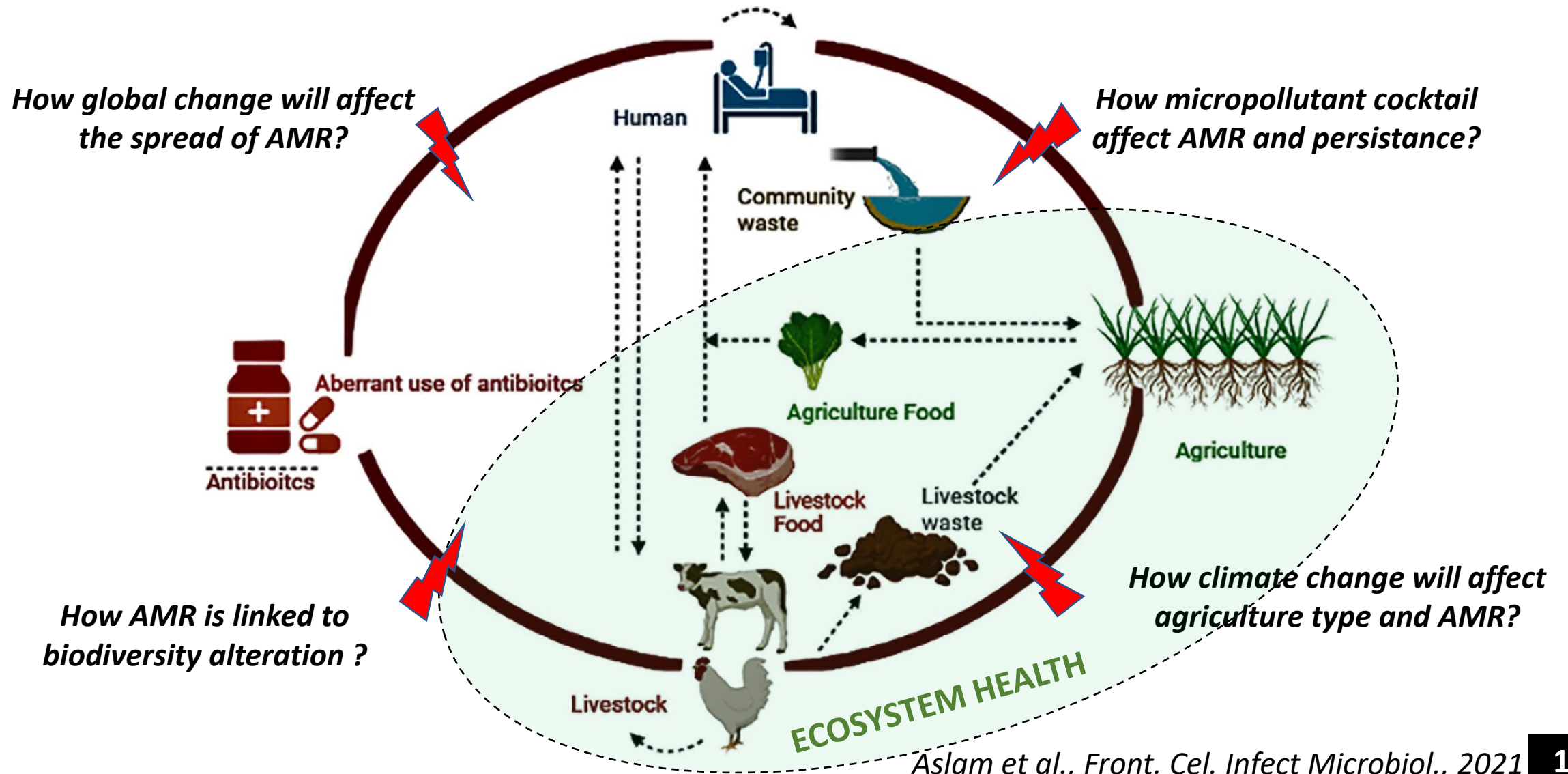
Cost estimates of micropollution and communication (e.g., labels)

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

Micropollutants at organisms – ecosystem interface : determinant of chronic diseases and infectious risks



The uncertain evolution of antimicrobial resistance (AMR) at the human-agriculture-ecosystem interface



Chemical toxic risks implicated on many levels of 'One Health'

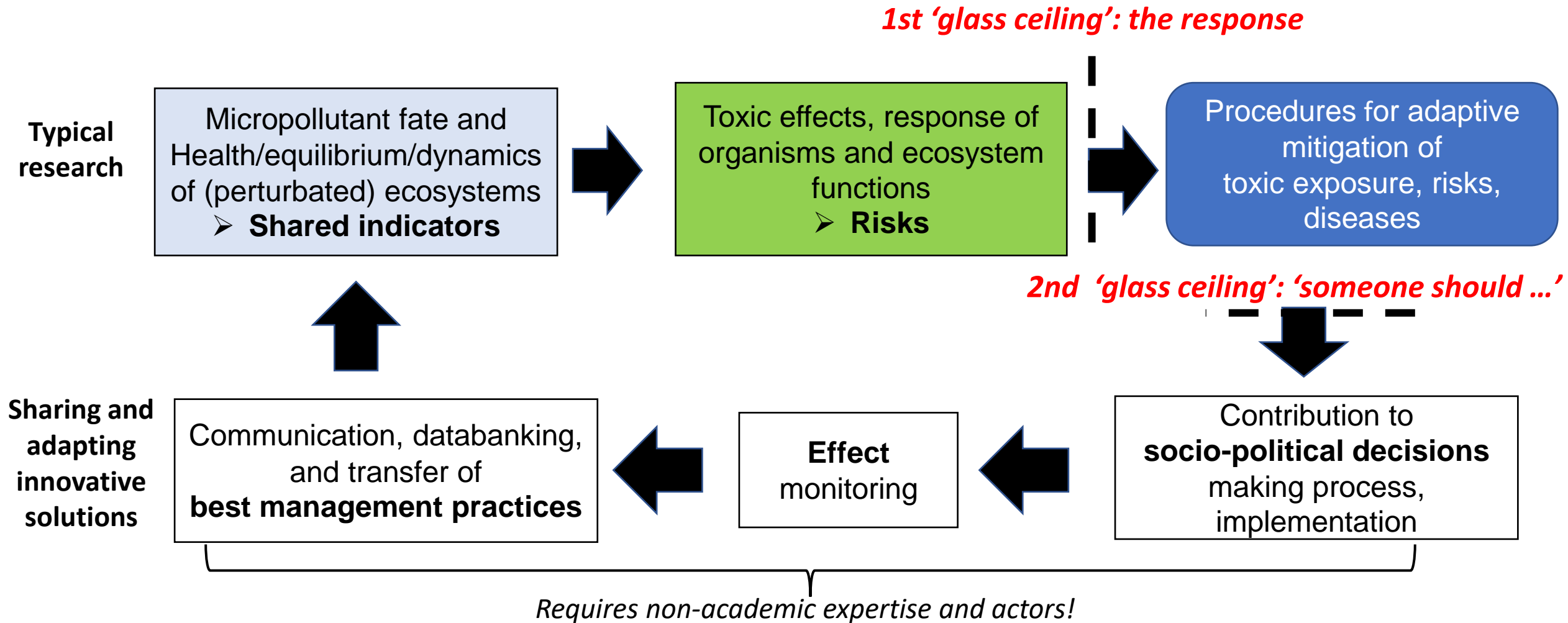
BUT...

***still marginal incorporation of micropollutants and environmental quality
into 'One Health' framework***

Why ?

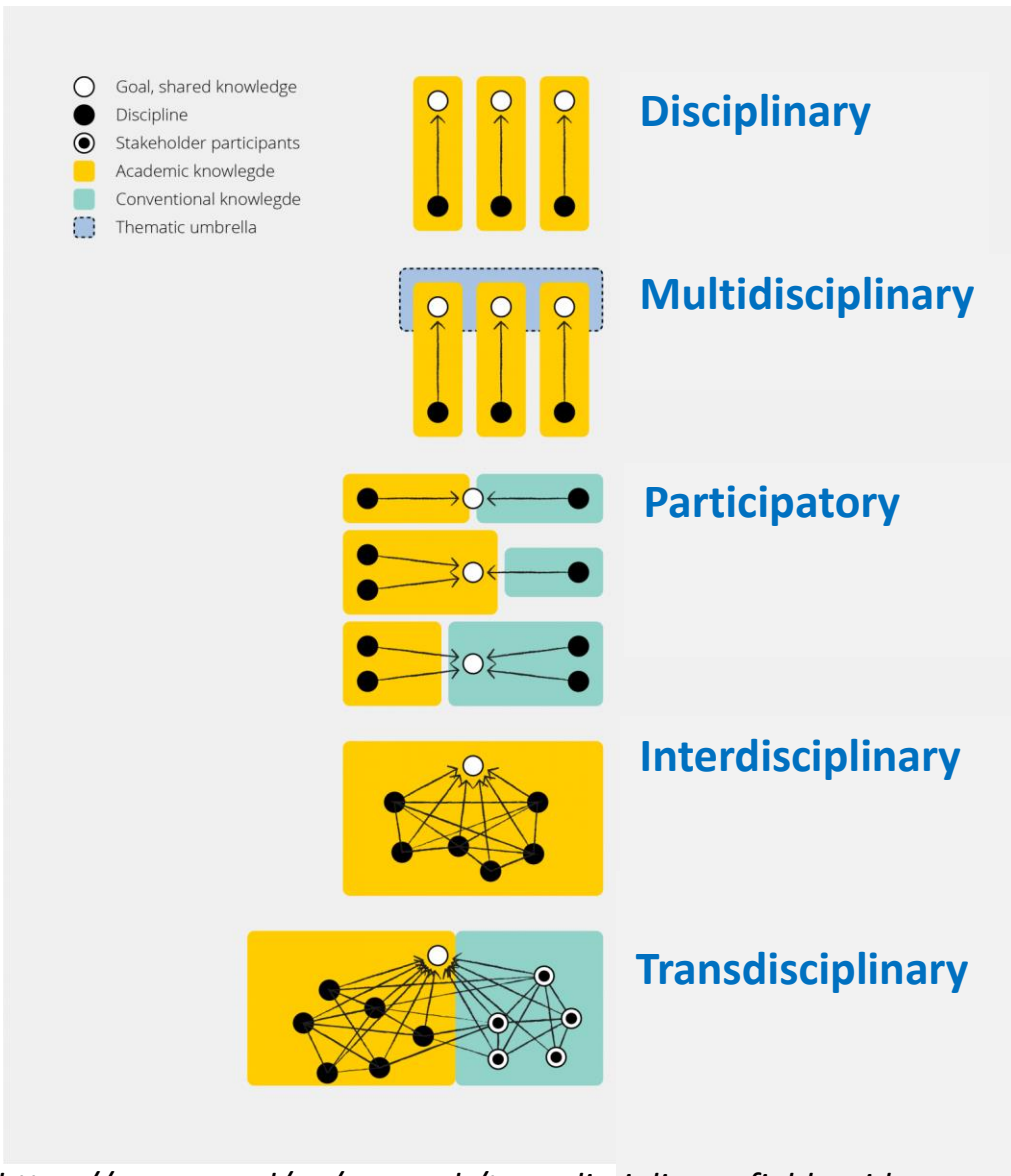
- ***Two main ceilings to break!***
- ***Towards harmonized frameworks: 'Ecosystem health' and 'One Health'***

Moving research beyond typical environmental research Drivers-Pressures-Status-Impact-Response



Interdisciplinary research on micropollutants should move towards transdisciplinarity for One Health

Towards 'One Health' framework including toxic risks of micropollutants



Medical / Veterinary: epidemiology, physiology, toxicology
Environmental : ecological, evolutionary and environmental sciences

Common umbrella: multifactorial and non-communicable diseases
 => **Strengthen :** **ecoepidemiology, ecophysiology, ecotoxicology**

Knowledge exchange: breaking down sectoral partitioning/co-training
 => **Bringing together communities:** space for regular/strategic exchanges
 => **Starting from usage to design research**

Integrated knowledge and networks: micropollutant-pathogen system

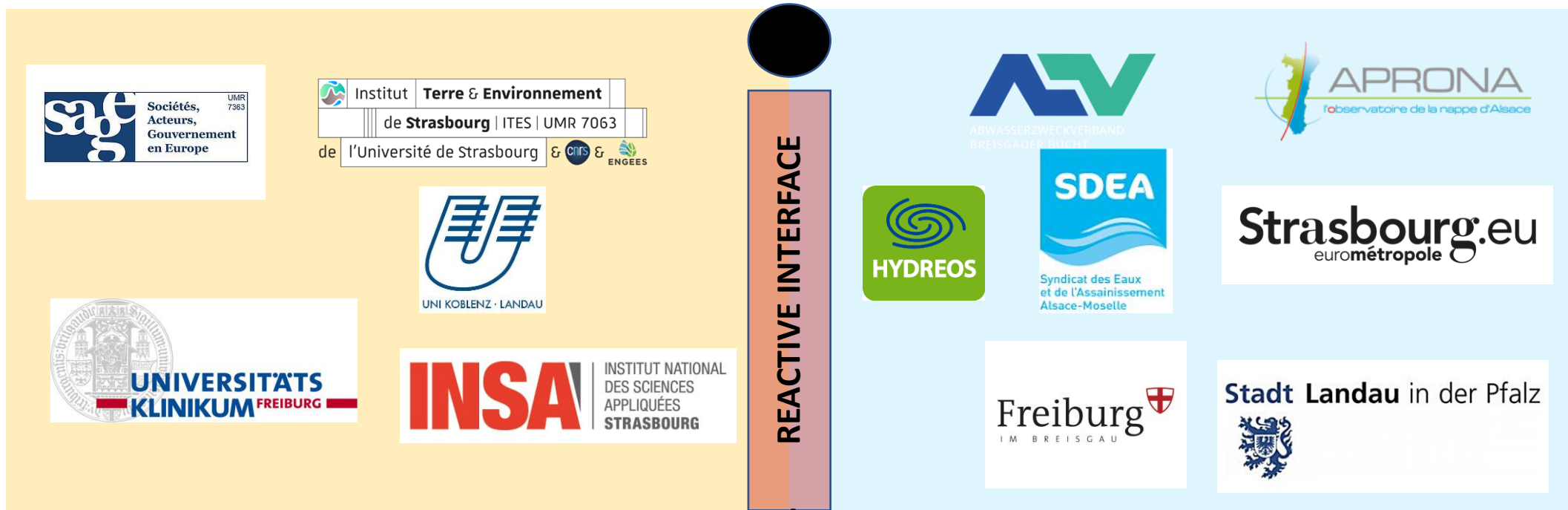
- Toxicant exposure and impact on immune-endocrine systems
- Multiple, chronic stresses and responses (individ./populat./community)
- (Epi-)genetic bases of population response to toxicants

Common goal: Integrated framework -health, agriculture and ecosystems

- Coordinated screening networks, databases, citizen actions
- Socio-economic, social justice and regulatory issues
- **Decision-making tools and defining future trajectories/scenarios**

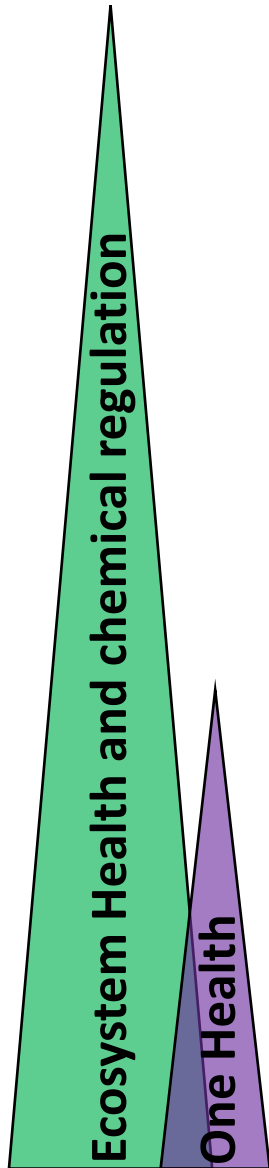
INTERREG project 'ReactiveCity' (2023-2027): towards a biocide-free city

- Eliminate building biocides and PFAS at source
 - Evaluate AMR and reduce antibiotics
 - Sustainable urban water management

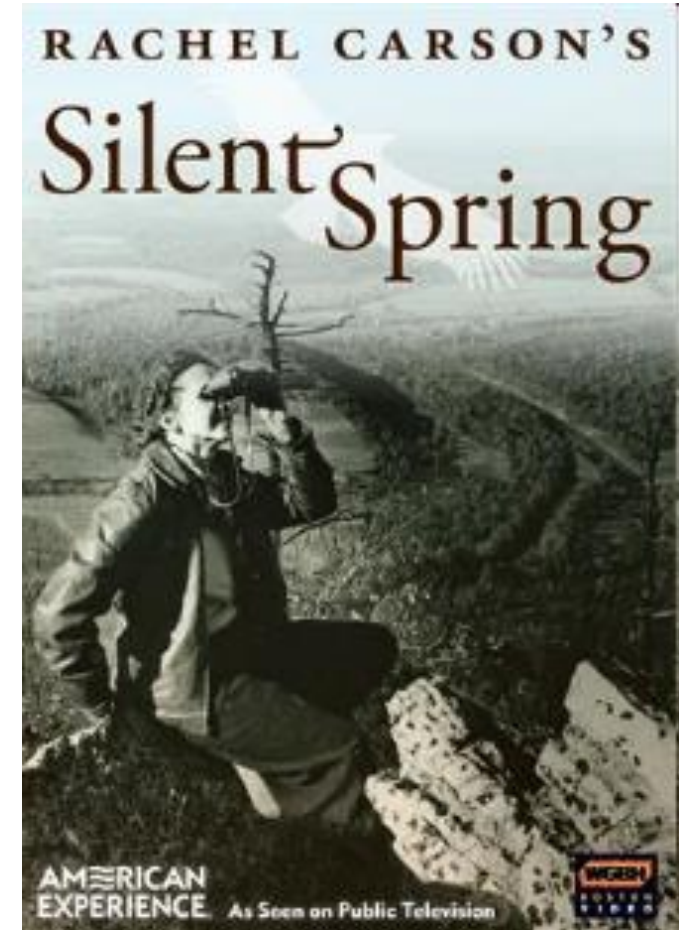


- *Regional reference diagnostics / Intercity comparison*
- *Risk mapping and decision tools*
- *Transboundary discussion and practice exchanges*
- *Awareness approaches and trainings*

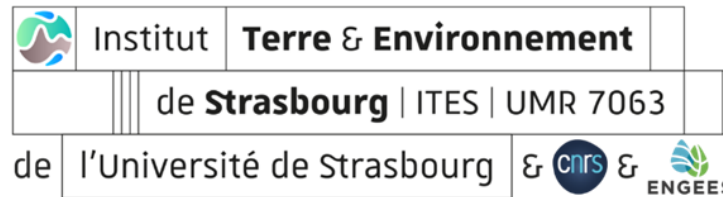
From Silent Spring to 'One Health' including chemical contaminants



<1930	Industrial chemical production
1962	Silent Spring (Rachel Carson)
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?



The team



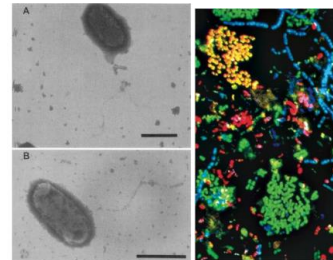
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MC ENGEES
Christophe Marcic
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Research activities:

- **Cities in transition,**
- **Transition for a sustainability of socio-hydrosystems**
- **Reflexive approaches to study socio-ecosystems**

*Join our conference cycle on
sustainability research!*