MEED: Progress of the multi-year Metals Environmental Exposure Data Program to anticipate the challenges of the EU Zero Pollution Ambition Policy and the Chemicals Strategy for Sustainability

[1]Hugo Waeterschoot,[2]Marnix Vangheluwe [1]and [1]Violaine Verougstraete

[1]Eurometaux, Tervurenlaan 168, 1150 Brussels, Belgium; [2]ARCHE Consulting, Liefkensstraat 35D, 9032 Ghent, Belgium

Contact: waeterschoot@eurometaux.be

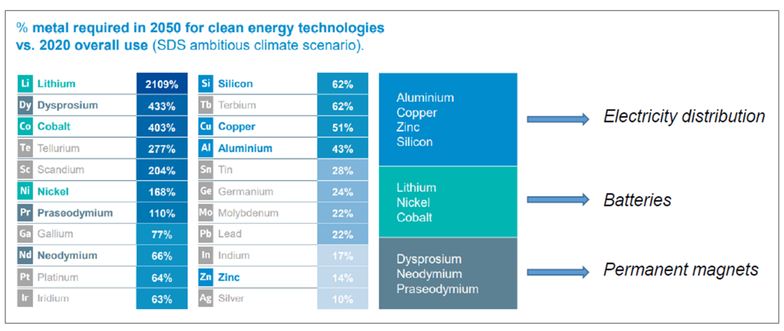
Background

As part of **the EU Green Deal**, the **Zero Pollution Ambition (ZPA)** aims at reducing *exposures of chemicals to levels that are no longer expected to be harmful to health and the environment*. **The Chemicals Strategy for Sustainability (CSS)** is one of the 3 pillars of this ambition. It is implemented through revisions of key chemicals legislations, in particular REACH and includes new challenges like the **Mixture Allocation Factor (MAF)** to demonstrate safe use and lack of impact on ecosystems of unintentional mixtures.

Volumes of metals in use are expected to sharply increase, considering the critical role metals play in reaching the climate and circularity objectives of the Green Deal (e.g., in (Electric Vehicle (EV))- batteries and solar cells). Hence, it is crucial to define today's ambient exposure situation and demonstrate that exposure to metals and their mixtures in the receiving environments will meet the objectives of the ZPA, the MAF and environmental compartment legislations, now and in the future, at regional and at local scale.

The EU metal sector has set up **MEED** as a comprehensive "**Environmental Exposure Data Gathering Program"**, complemented by development of scientific concepts, to comply with the ZPA and biodiversity objectives. Its timeline (2022-'24) allows to feed the outcomes into regulatory debates (e.g., REACH 2.0, ZPAP, revision Soil & Water frameworks).

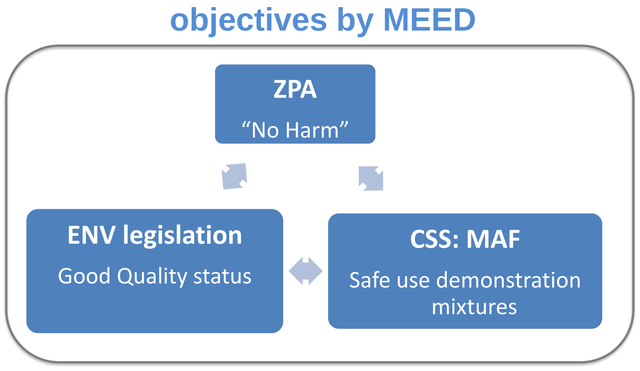
Expected growth rate of metals in EU by 2050[1]



Need for metals and emission challenges

- ✓ The **EU Green Deal** stimulates the use of a large series of metals for uses contributing to the Climate, Energy and Chemicals transition to a more sustainable society.
- ✓ This results in **multifold increases** for some metal & materials that can be gained from recycling, longer lifecycles of substances in articles for a given function (e.g., mobility) and mining to fill the growth gap
- ✓ Increased production, use in articles & recycling could **increase emissions**, which might be contrary to the aims of the ZPA.

Anticipated regulatory protection objectives by MEED



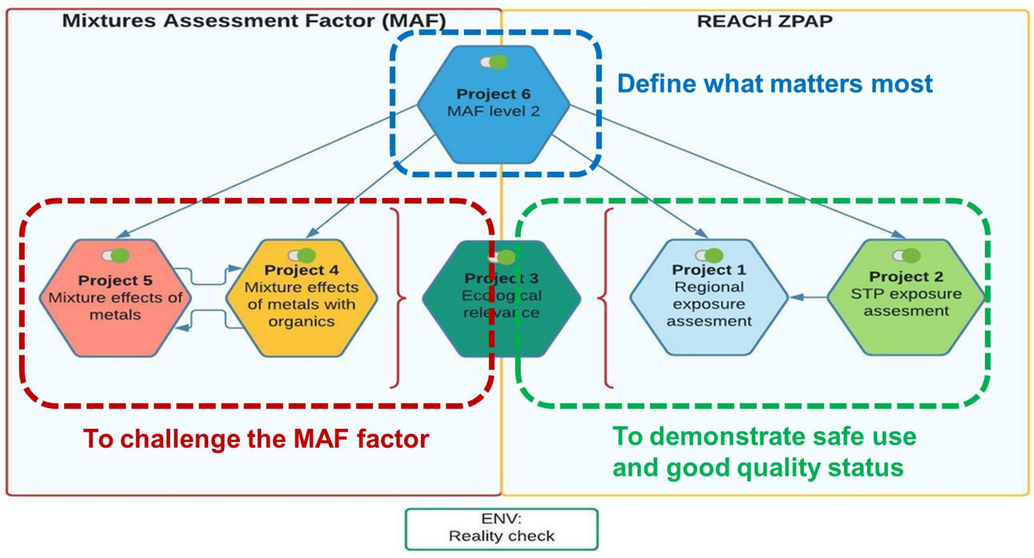
Pillar 1: Anticipate the MAF in REACH

- Define I-PCS "**Inorganic-Priority Contributing Substances**" (P6) to provide focus and efficiency
- Can we determine the combined metal mixture effects for I-PCS (P5) and the combined metals-organics mixture effects (P4)?
- Can we demonstrate "**no harm** to environmental compartments & biodiversity" for "future proof" with ZPA and SDG 15 (P3)?

Pillar 2: Update and predict regional exposure concentrations

- Map **today's metal concentrations** and combined risks across the EU, trends & predicted future concentrations due to volume increase (P1)
- Improve the assessments of **consumer and professional releases**, given a weak link (P2)
- Demonstrate **Good Quality Status** and "no harm to the environment" (P3)

Structure of the MEED program



Already achieved 5 milestones in '22

1. Confirm the extent of the **MAF factor impact**
2. Identify **what metals matters most** (I-PCS)
3. Review existing knowledge on **todays's regional background** for metals (water and soil)
4. Review existing **knowledge on** metals mixtures and metal-organic **mixture interactions**
5. **Designing the test phase** for the metals mixture interactions

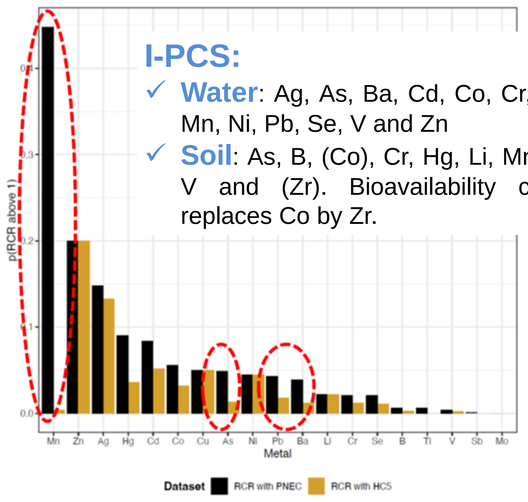
Percent Exposure Scenarios at risk due to MAF

MAF	Freshwater ES at risk	Soil ES at risk	Combined
1	0 %	0 %	**0 %**
2	19 %	20%	**29 %**
3	39 %	35 %	**47 %**
5	52 %	41 %	**63 %**
10	65 %	57 %	**76 %**

Significant impact on environmental exposure assessment

Some first results

Project 6: I-PCS

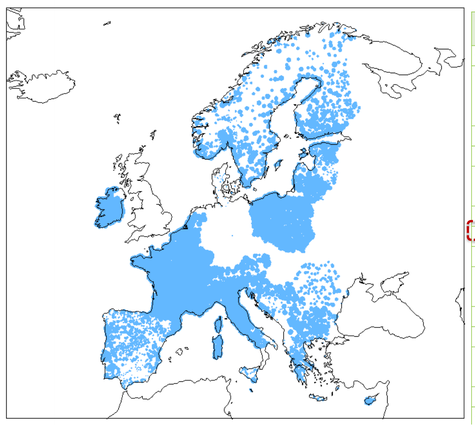


I-PCS:

- ✓ **Water**: Ag, As, Ba, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Se, V and Zn
- ✓ **Soil**: As, B, (Co), Cr, Hg, Li, Mn, Ni, Se, V and (Zr). Bioavailability correction replaces Co by Zr.

Proportion of monitoring samples potentially at RISK (RCR>1) in Waterbase, based on PNEC or EC5 (ref. REACH)

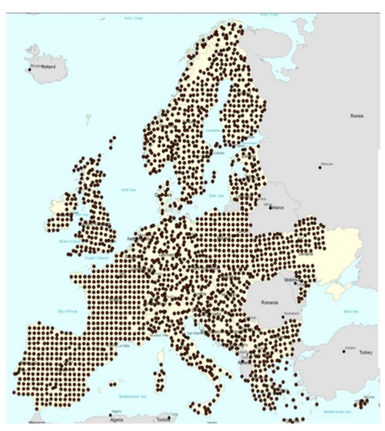
Project 1: Regional exposure update



Spatial distribution of surface water samples in Waterbase

Inorganic	Before data processing	After data processing
Ag	20 954	5 595
As	189 824	163 341
Ba	35 274	33 917
B	48 674	40 102
Cd	278 072	233 094
Co	45 785	30 033
Cr	222 037	185 970
Cu	245 462	184 935
Hg	212 579	178 944
Li	1 783	489
Mn	95 172	71 170
Mo	25 465	25 342
Ni	275 291	240 689
Pb	280 208	241 503
Sb	30 551	30 145
Se	49 235	37 156
Ti	14 749	14 267
V	55 094	49 220
Zn	210 488	145 225

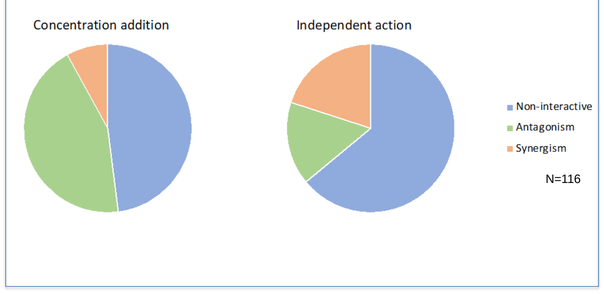
Metal samples in Waterbase



Spatial distribution of soil samples in GEMAS

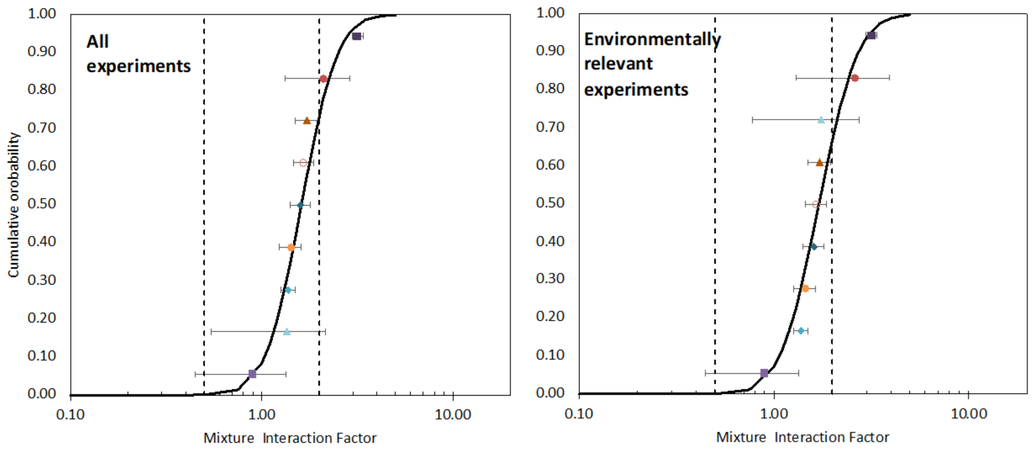
Project 5: Literature reappraisal metal-mixtures

How frequent do statistically significant **deviations from the CA or IA models** occur given synergistic effects are of scientific and regulatory concern.



Interpretation: Existing monitoring datasets are extensive even after data processing for LOQ. However, data lack on some critical metals relevant for the Green Deal (e.g. lithium, Rare Earths)

Project 5 : literature reappraisal metal-mixtures[2]



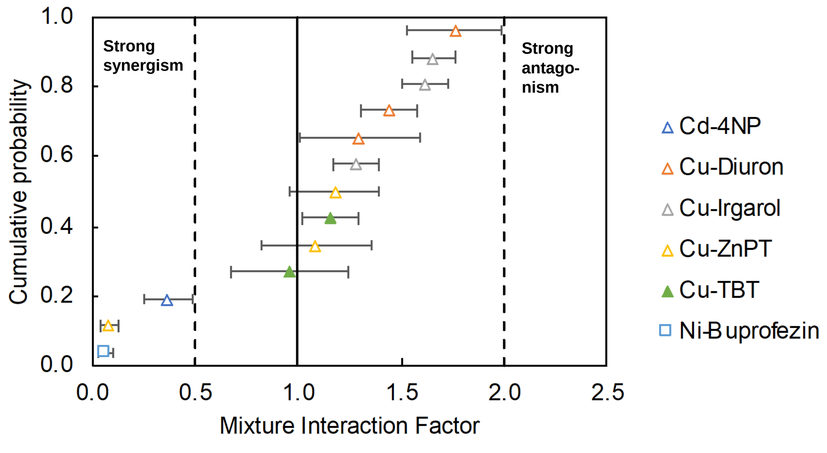
Mixture Interaction Factor

Is the degree of conservatism that ***CA*** (standard regulatory mixture model) provides relative to observed mixture effects at low effect levels (i.e. 10% mixture effect)

MIF < 1 = synergism

MIF > 1 = antagonism

Project 4: literature reapproasal metals-organics mixtures[2]



References: [1]Metals for Clean Energy – Pathways to solving Europe's raw materials challenge" , [2]Martin et al. 2021 Environ. Int I 46 106206

Detailed SETAC-DUBLIN Posters: Regional exposure WE344, Reappraisal metal-mixtures WE344, Reappraisal metals-organic mixtures TH299Metal-organics smart test design TH304, MIF for Increasing number of metals in mixture WE343

Conclusions on MEED so far

- ✓ **Metal volumes** manufactured, used and recycled, will increase significantly due to the Green Deal objectives, hence questioning the impact on the environment.
- ✓ **MEED aims** at collecting up to date exposure evidence and predicting future environmental exposures relevant to anticipate the ZPA, MAF and new and updated EU environmental compartment legislations
- ✓ **Aquatic and soil regional monitoring data**sets for a long series of metals were collected and checked for metals combined concentrations and risks. Datasets for some metals that are key for the Green Deal like Li and rare Earths are limited or lacking.
- ✓ The **Mixture Interaction Factor (MIF)** allows to define the level of conservatism provided by the Concentration Addition model
- ✓ The literature on metals mixtures and metal-organic mixtures was **updated and reappraised demonstrating** that MIFs for metals mixtures and for metals-organics are larger than 1, hence leaning more to antagonistic than synergistic
- ✓ A **smart testing design was applied** to complement gaps on environmentally relevant metals-mixtures
- ✓ The **outcome of the MEED program** will be published and available for regulatory compliance demonstration

Acknowledgements: this research is funded by Eurometaux and its members