

# Binary metal organic mixtures: Who drives the risk in European freshwater?

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## Introduction

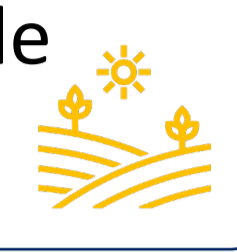
Ecological risks of chemical mixtures is mainly assessed for groups of single or similar substances rather than across different groups of chemicals!

- Very few chronic metal + organic mixture toxicity studies available (2008-2023)
- Mainly algae tests assessing Cu + Antifoulant substances
- Tests outside environmentally or regulatory relevant concentrations

**Aim:** to prioritize binary metal+organic mixtures of environmental and regulatory relevance by using monitoring data and PNECs

This work is part of the comprehensive Eurometaux

"Metals Environmental Exposure Data" program (MEED) as project 4.



## Methods

### 1. Monitoring Data from Waterbase

Waterbase:

- European freshwater Monitoring Database
- EEA database with data provided by Member states



- Rivers and lakes only
- Recent data 2010 onwards



Final Dataset:

- Measured conc. = LOQ: → removed
- Measured conc. < LOQ: → set to 0
- Dissolved metal concentrations

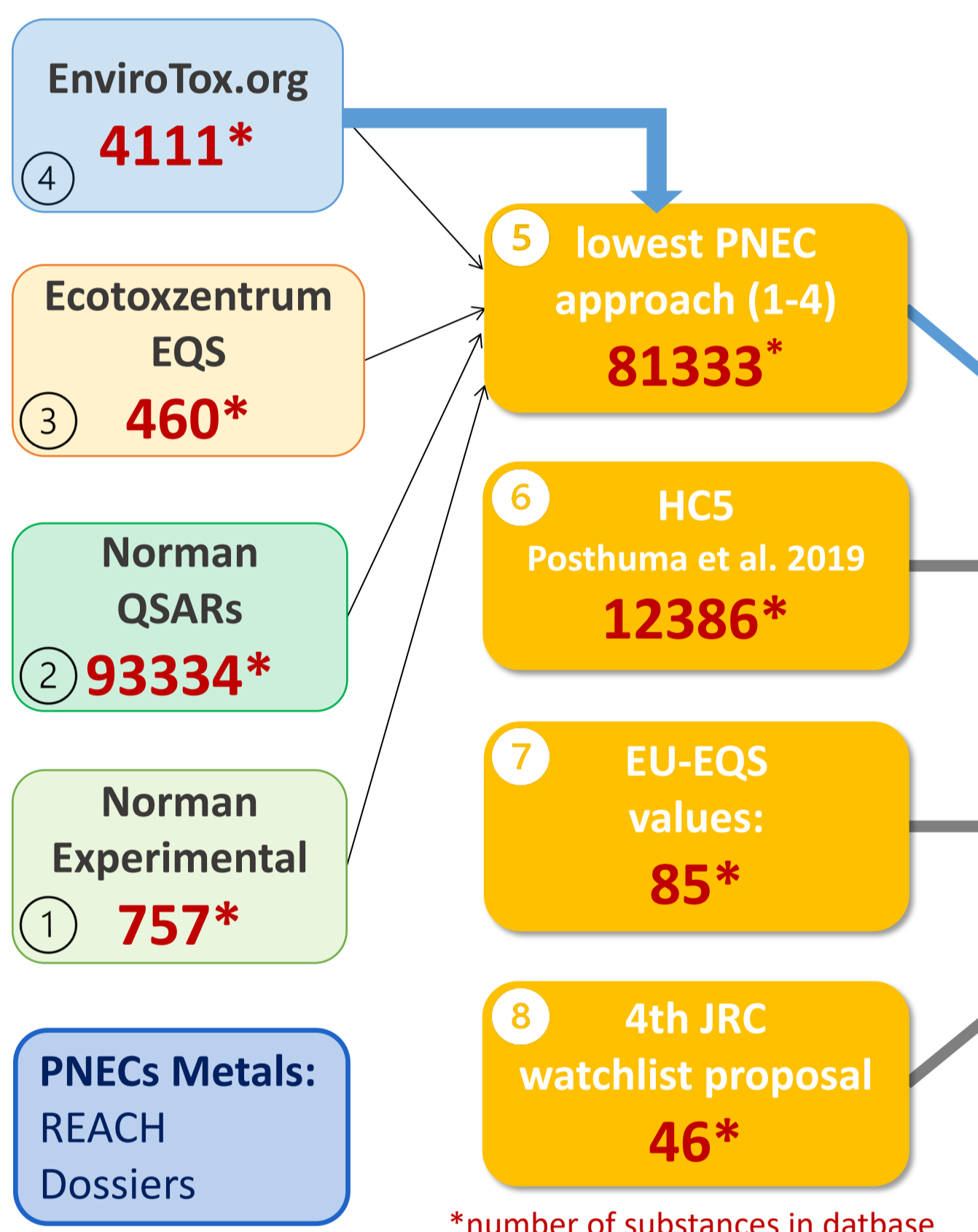


## 2. Retrieve regulatory threshold values

## 3. Assign Endpoints to substances

## 4. Calculate Hazard Index and BMRF

## Priority Substances



Assigned Hazard Index Endpoints:

- lowest PNEC: 573
- Norman Exp.: 383
- Norman QSAR: 342
- Ecotoxzentrum: 227
- EnvTox.org: 475

regulatory relevant endpoints

Hazard Index End-points

588 organic substances (in Waterbase with unique CAS-number)

- HC5: 460
- EU-EQS: 62
- 4th JRC Watchlist: 8

\*number of substances in database

$$HQ_{met} = \frac{C_{measured_{met}}}{PNEC_{met}} \quad \text{and} \quad HQ_{org} = \frac{C_{measured_{org}}}{PNEC_{org}}$$

$$HI_{mix} = \sum HQ_{met,org} > 1$$

AND %HQ<sub>met</sub> > 10% AND %HQ<sub>ORG</sub> > 10%

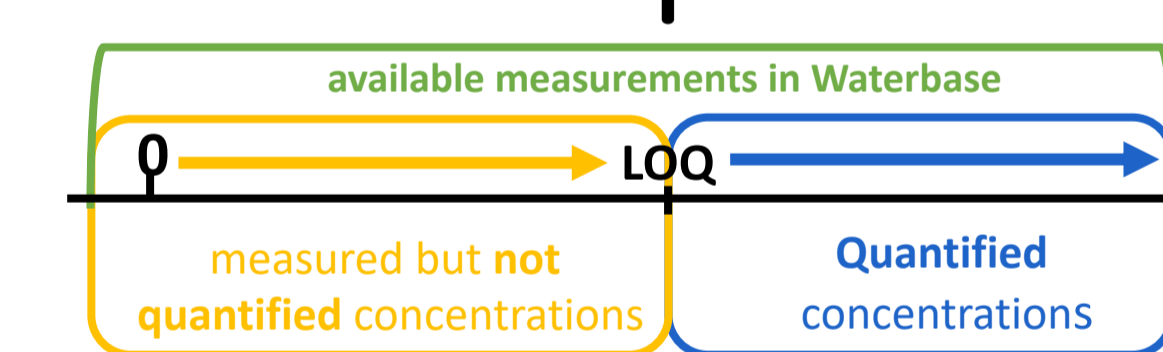
count: cases at risk

$$BMRF \% = \frac{\text{cases at risk}}{\text{joint measurements}} \times 100$$

Binary Mixture Risk Frequency:

From all Binary mixtures of a certain metal + organic present at EU scale (all available Waterbase measurements), X% of all mixtures are at risk. Risk means HI<sub>mix</sub> > 1.

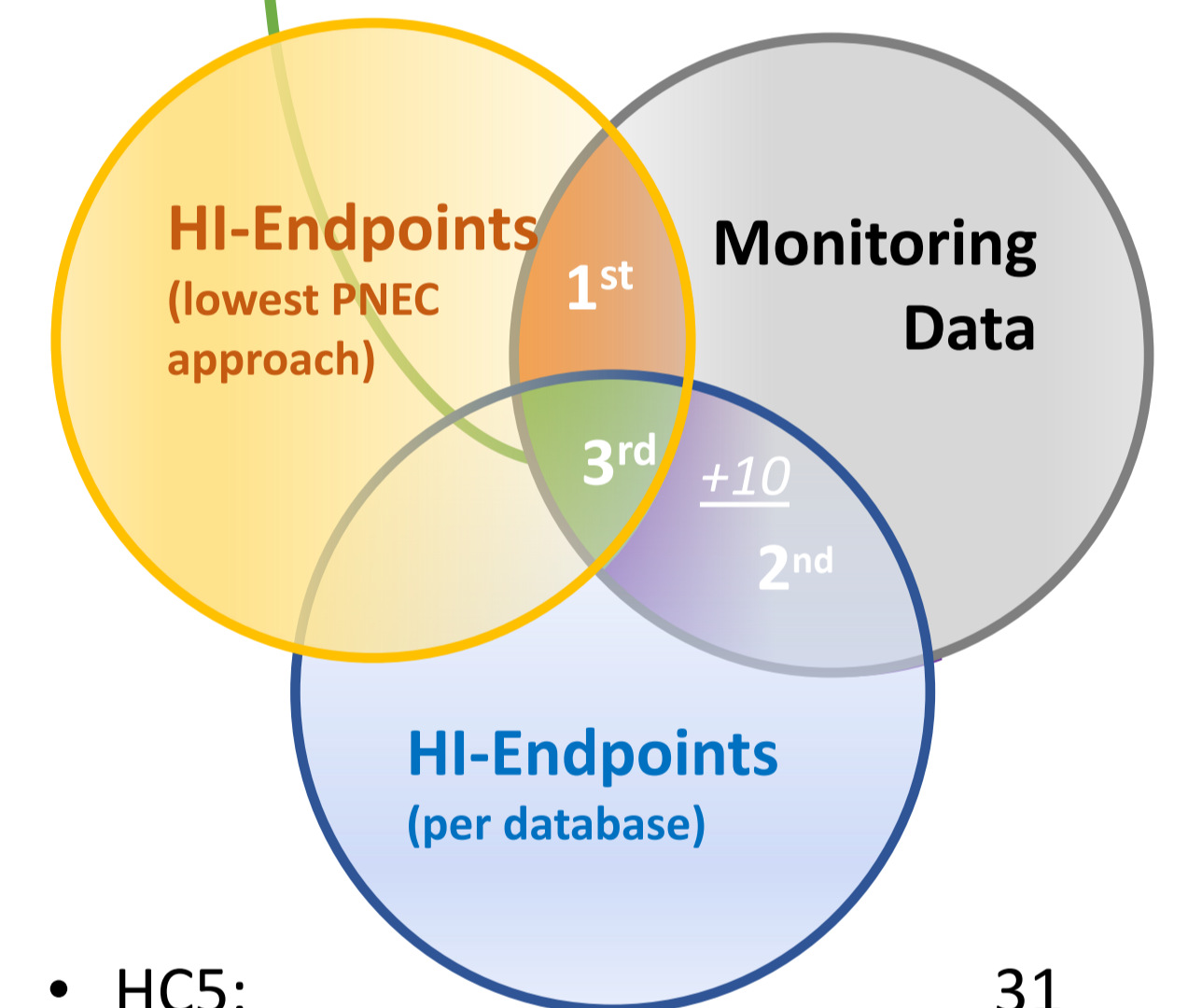
count: all joint measurements



lowest PNEC from: 85 substances

- Norman Exp.: 63
- Norman QSAR: 52
- Ecotoxzentrum: 44
- EnvTox.org: 30

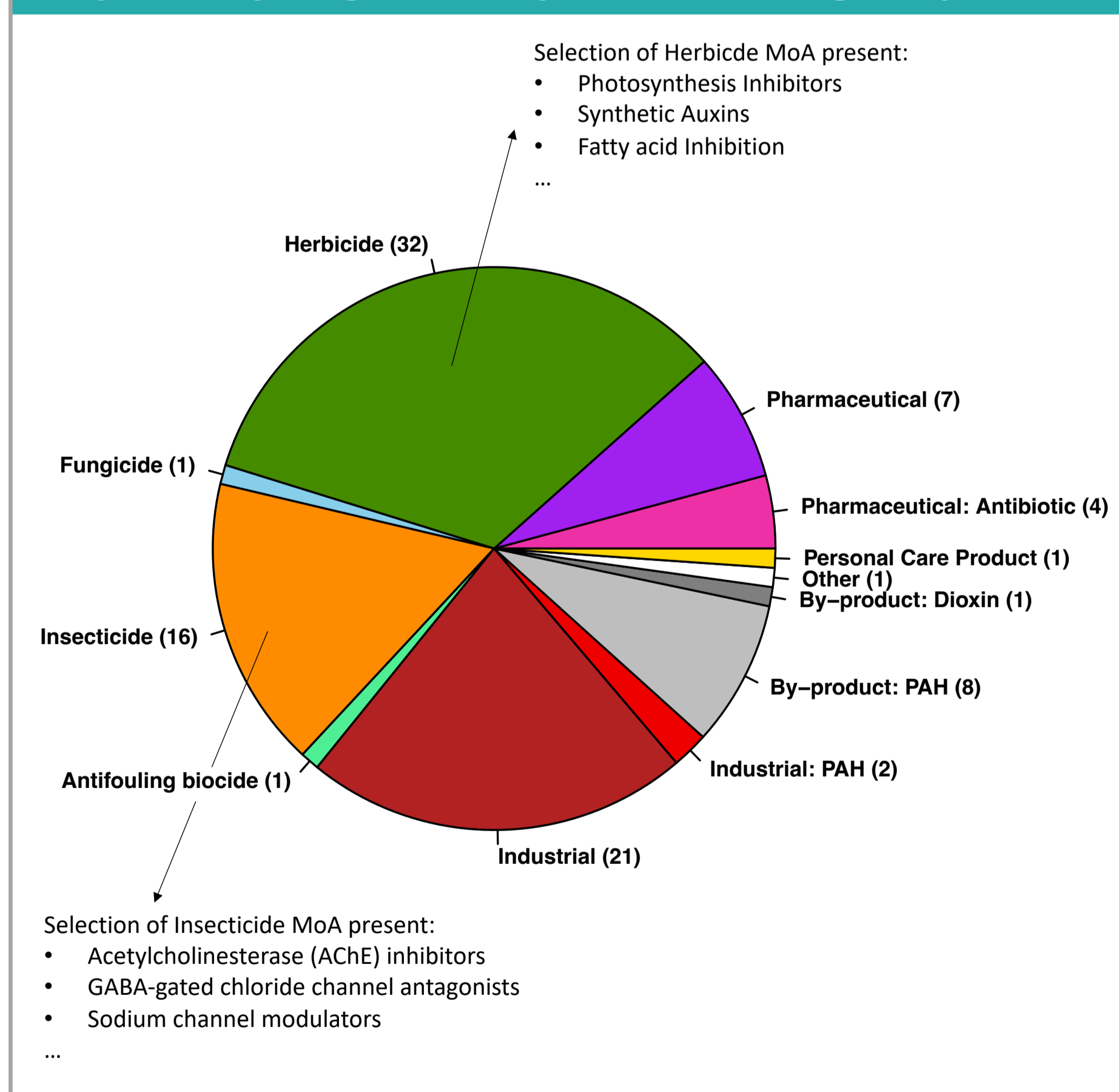
adjusted lowest PNEC: 95 substances



- HC5: 31
- EU-EQS: 23
- 4th JRC Watchlist: 3

## Results

### 95 priority organics by substance group



Selection of Herbicide MoA present:

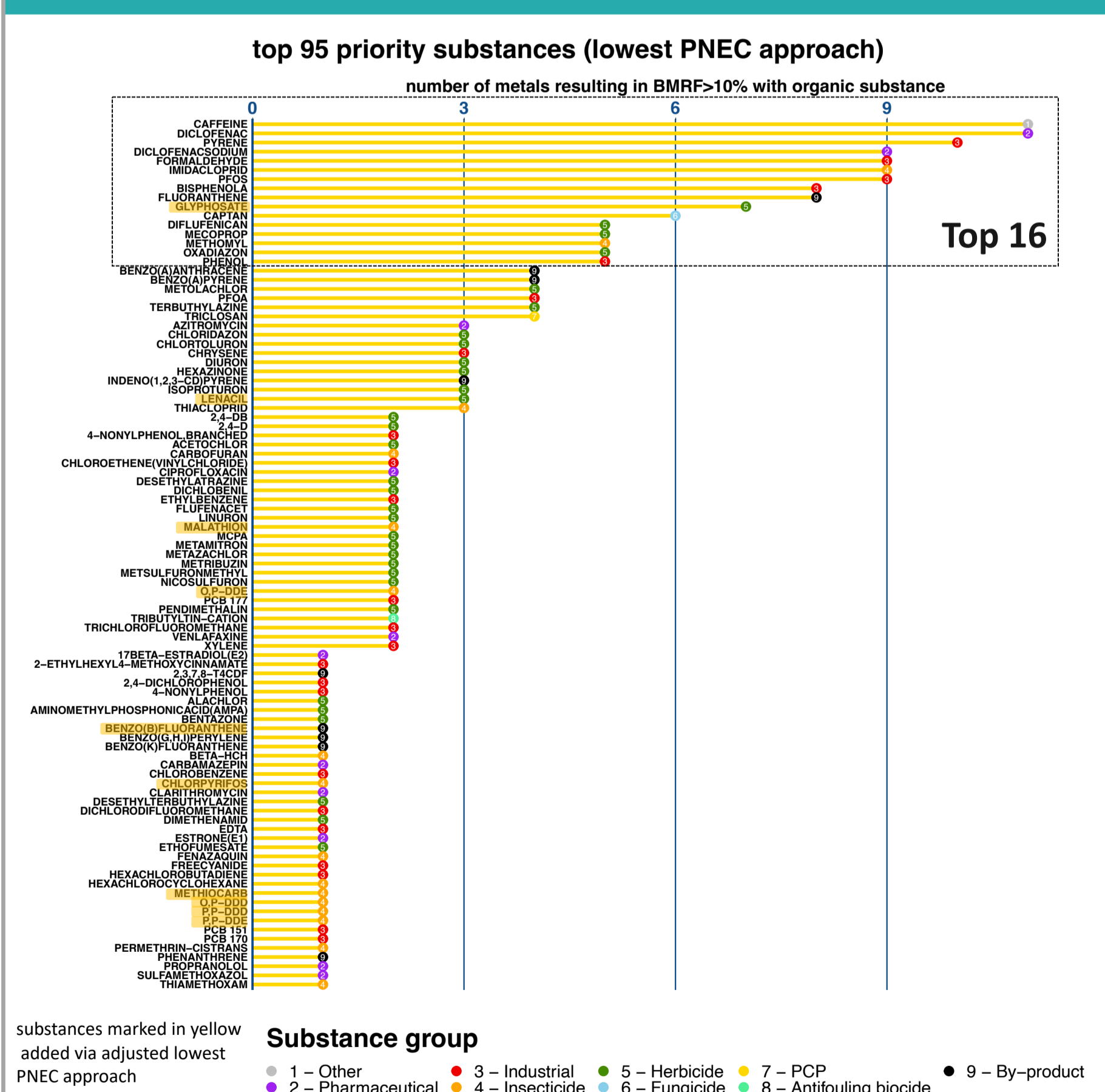
- Photosynthesis Inhibitors
- Synthetic Auxins
- Fatty acid Inhibition

Selection of Insecticide MoA present:

- Acetylcholinesterase (AChE) inhibitors
- GABA-gated chloride channel antagonists
- Sodium channel modulators

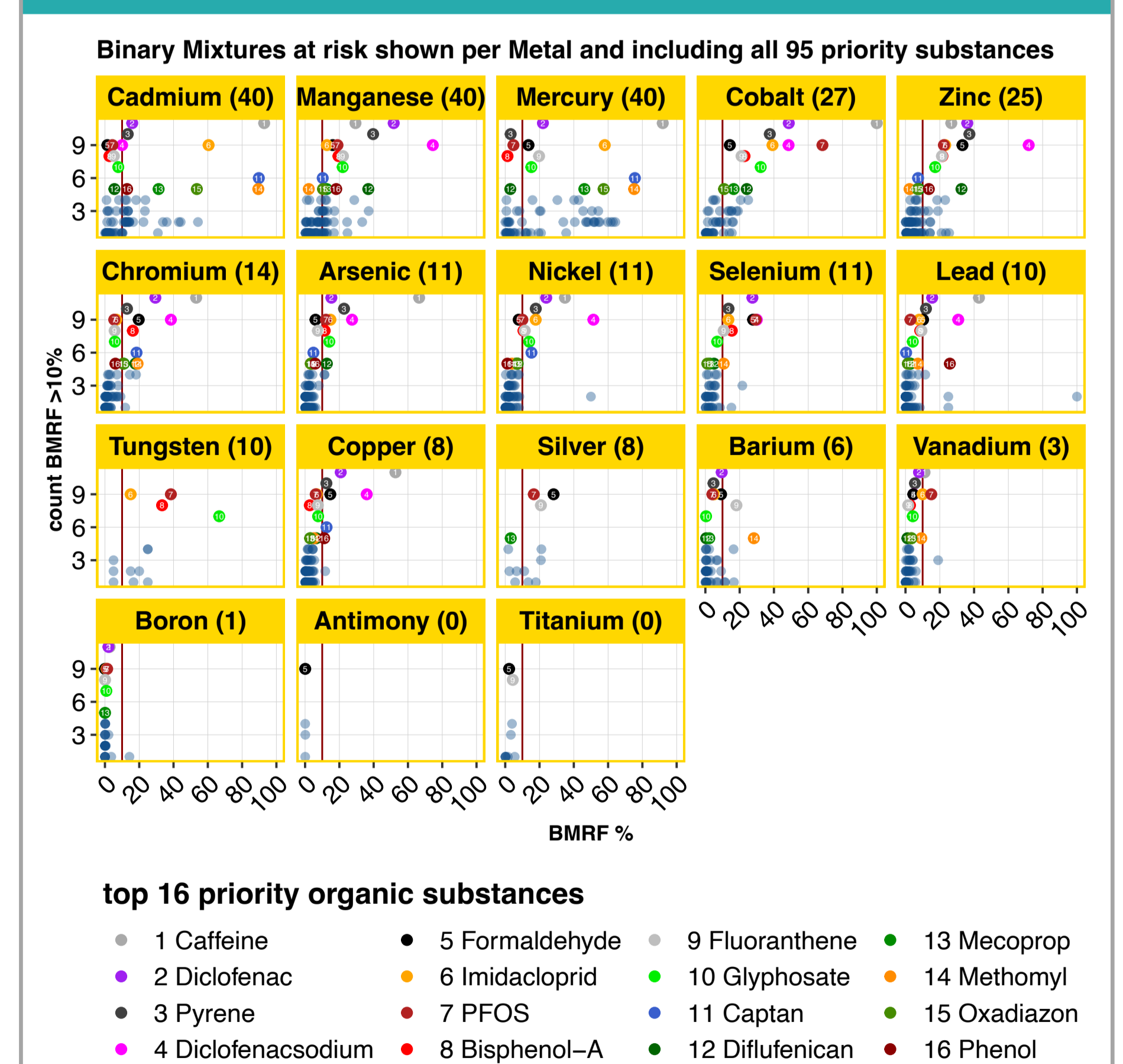
- Major Substance groups are Pesticides, Industrial Chemicals, Pharmaceuticals and PAHs
- Various Modes of Actions present in each Group

### Identified organic priority substances



- 32 organics with a BMRF > 10% with ≥ 3 Metals
- Remaining 63 → substance specific mixtures (BMRF > 10% with 1 or 2 metals only)

### Binary Metal+Organic mixtures at Risk



- 16 high priority organics identified, all having a BMRF > 10% with 5 or more metals
- Cd, Mn, Hg in binary mixtures with BMRF > 10% with 40 priority substances

**Conclusion:** Metal+organic mixtures were prioritized by their Binary Mixture Risk Frequency (BMRF), using European monitoring data (Waterbase) and a PNEC based Hazard Index to ensure regulatory relevance.

- Of 588 single organic substances identified in Waterbase, 95 substances are of priority (BMRF > 10% with ≥ 1 Metal).
- 16 substances are of high priority, (BMRF > 10% with ≥ 5 Metals), and are potential candidates for a testing program.

**Outlook:**

- Toxic unit (TU) based Prioritization
- Lab tests with substances of priority under PNEC and TU based Prioritization + relevant MoA

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