PMT substances: Persistent, mobile and toxic

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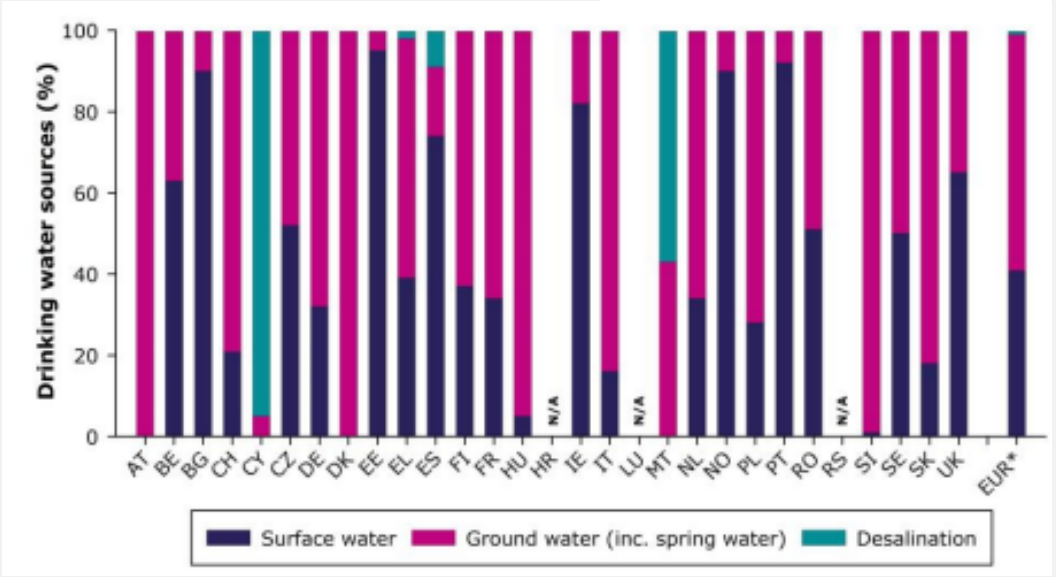
Safe water

- Ground water and surface water are used for drinking water production
- Protection for today and tomorrow

EurEau



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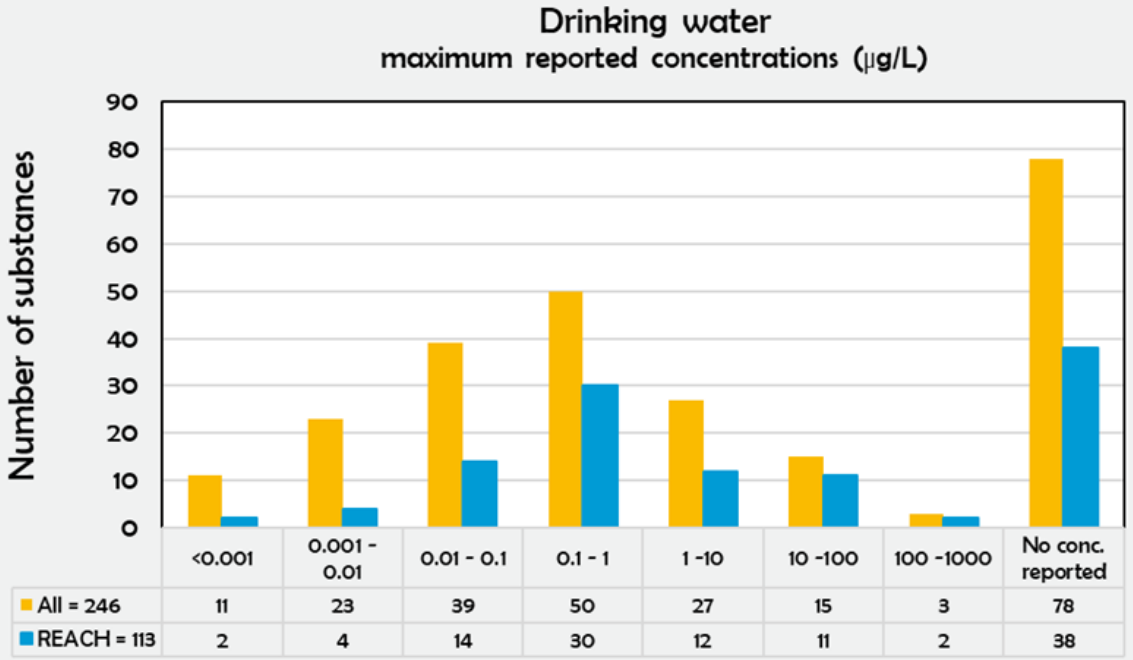
Monitoring: substances in drinking water

- Summary of 25 Studies conducted between 2000-2018
- 58% of REACH substances have a maximum reported concentration > 0.1 µg/L
- 40% of other substances have a maximum reported concentration > 0.1 µg/L

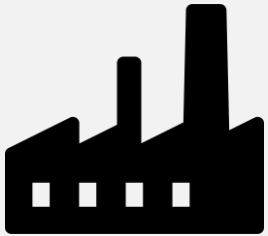


	<0.001	0.001 - 0.01	0.01 - 0.1	0.1 - 1	1 -10	10 -100	100 -1000	No conc. reported
All = 246	11	23	39	50	27	15	3	78
REACH = 113	2	4	14	30	12	11	2	38

Arp and Hale, 2019

Huge variation !

Properties of a drinking water contaminant



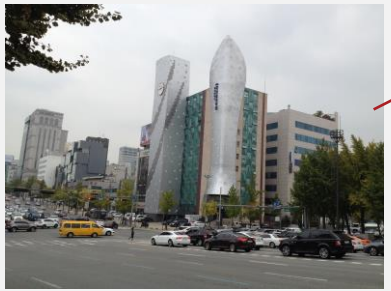
Chemical Synthesis

Persistent and Mobile

Transport through the environment or infrastructure

Water treatment and production

Consumption



Uses / Products

Toxic

PMT/vPvM substances

Concerns with PMT/vPvM substances

- The chemical industry innovates all the time
- Risk assessment cannot keep up
- Persistent chemicals accumulate
  => exposure (E) increases
  => risk (R) increases:
- R = H x E

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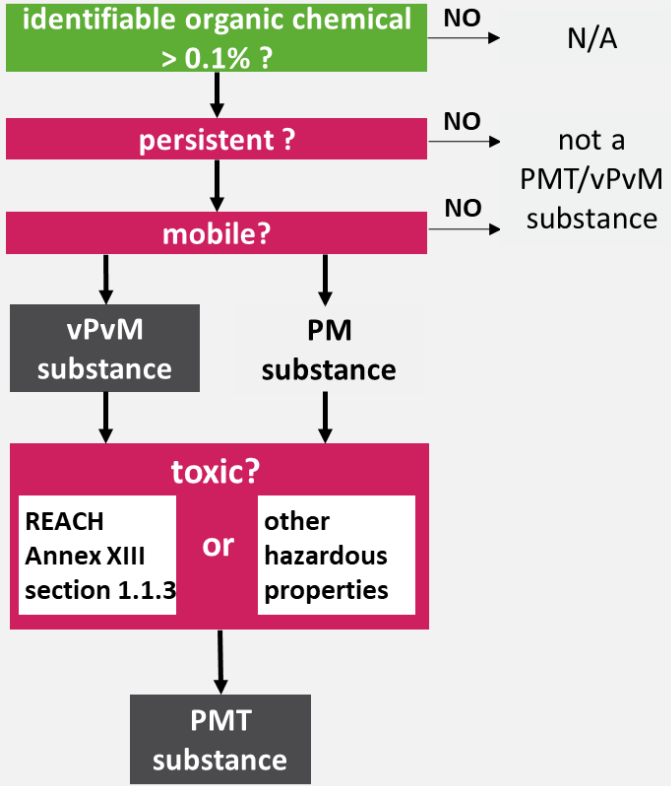
Europe's environment – State and Outlook https://www.eea.europa.eu/publications/soer-2020/chapter-10_soer2020-chemical-pollution/

PMT/vPvM substance criteria and guidelines

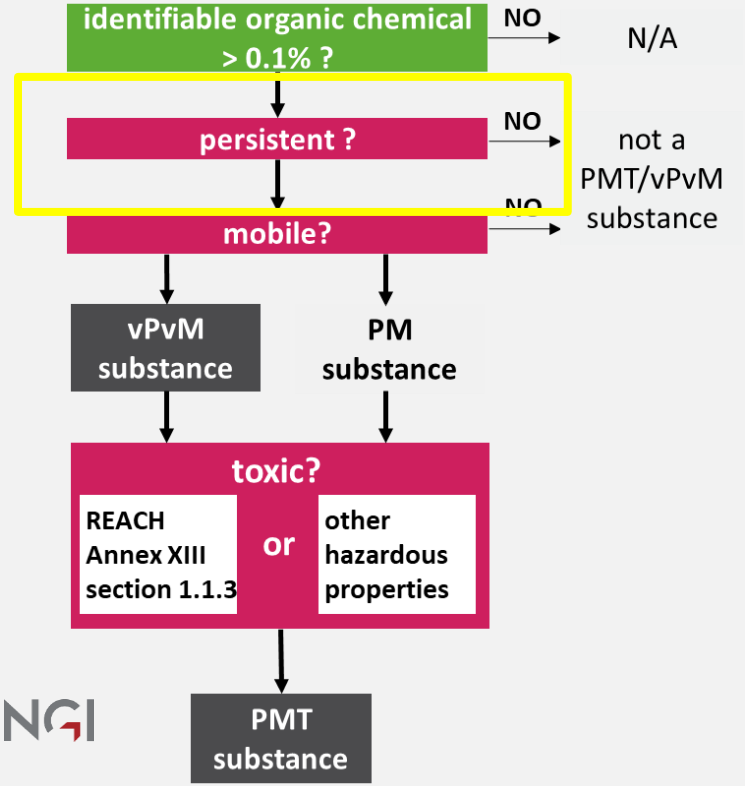
Scientific Background and Guidelines



PMT/vPvM Criteria

Assessing persistency (P and vP)

Starting with 9742 substances

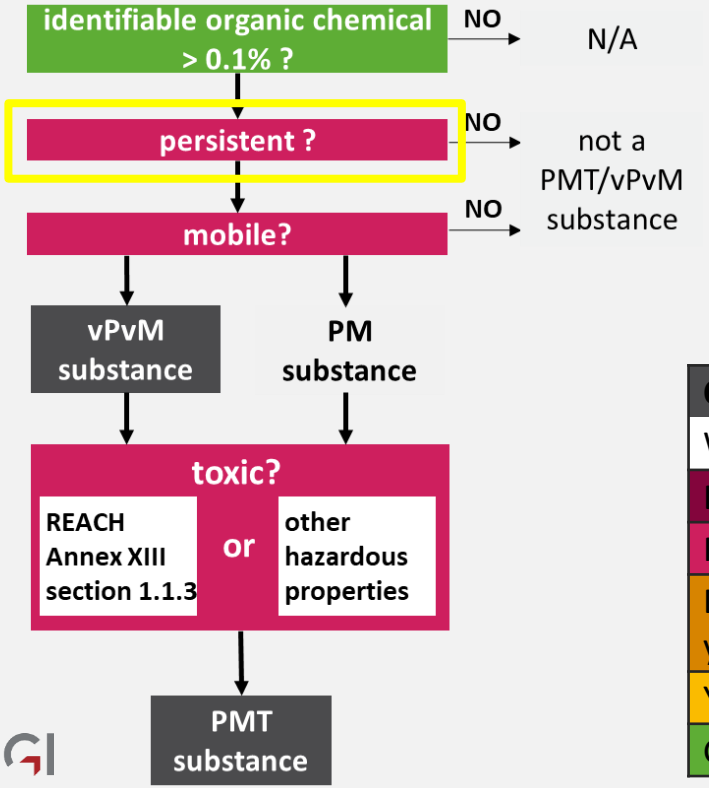


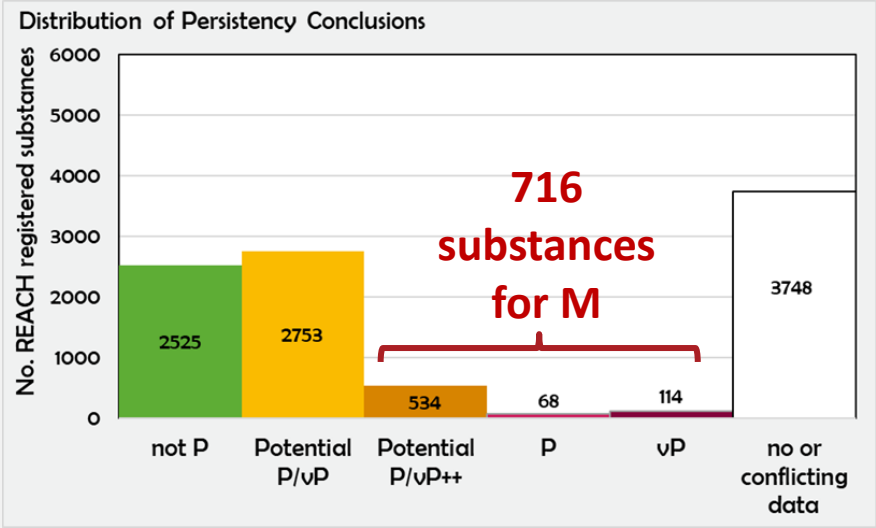
P and vP criteria identicle to Annex XIII of REACH

	persistent (P) in any of the following situations	**very persistent (vP)** in any of the following situtations
marine water	half-life > 60 days	half-life > 60 days
fresh water	half-life > 40 days	half-life > 60 days
marine sediment	half-life > 180 days	half-life > 180 days
fresh water sediment	half-life > 120 days	half-life > 180 days
soil	half-life > 120 days	half-life > 180 days

ECHA Chapter R.11. Version 3.0 (June 2017)
Neumann & Schliebner (2019)

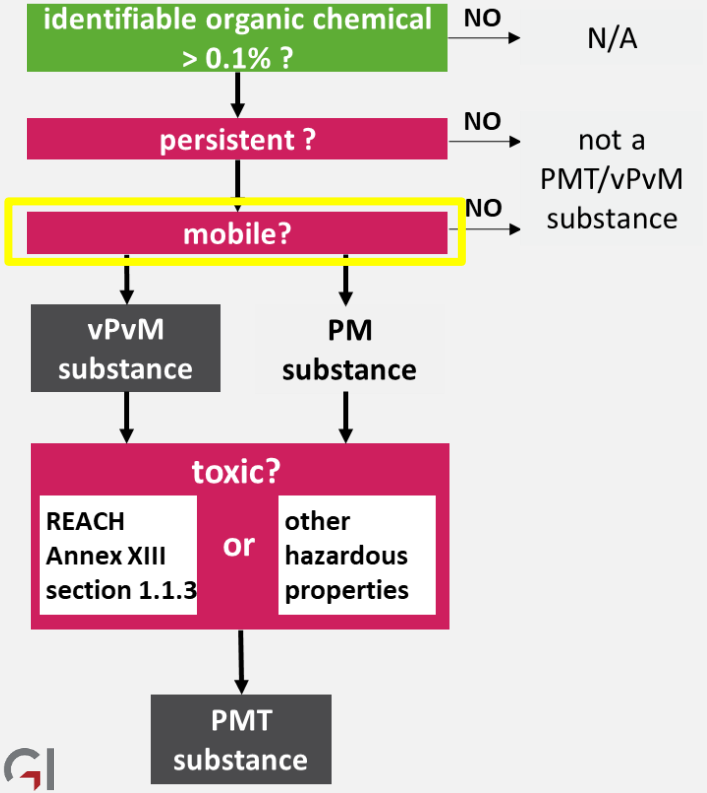
Persistency, results





Colour	Data Quality
White	Data missing or data quality too poor/inconsistent
Dark red	High quality data indicating vP
Red	High quality data indicating P, and maybe vP
Dark yellow	"Potential P/vP++“ sufficient weight of evidence that P or vP is met, unclear which.
Yellow	Some data but insufficient to make a conclusion
Green	High quality data for “notP”

Assessing Mobility



Mobile Criterion (M)

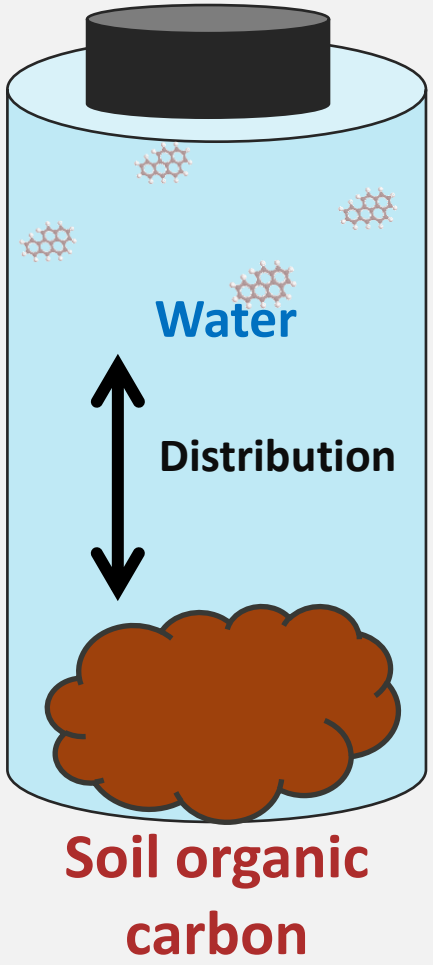
	Mobile (M) if it fulfills P or vP and the following situation	**very mobile (M)** if it fulfills P or vP and the following situation
lowest experimental **log K_{OC}** (pH 4-9)	≤ 4.0	≤ 3.0

Neumann & Schliebner (2019)

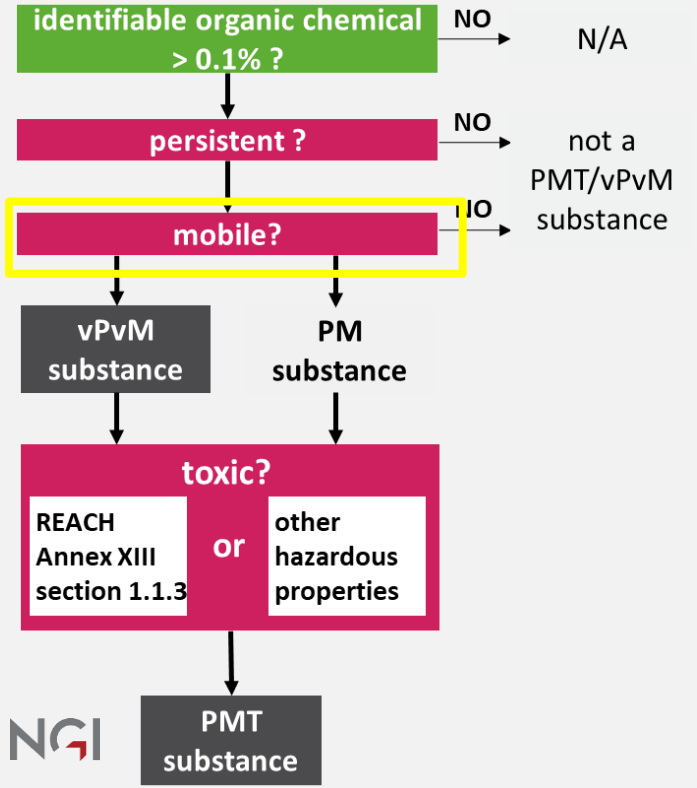
What is log K_{OC}?

K_{OC} : equilibrium distribution of a chemical between water and organic carbon in either soil or sediment

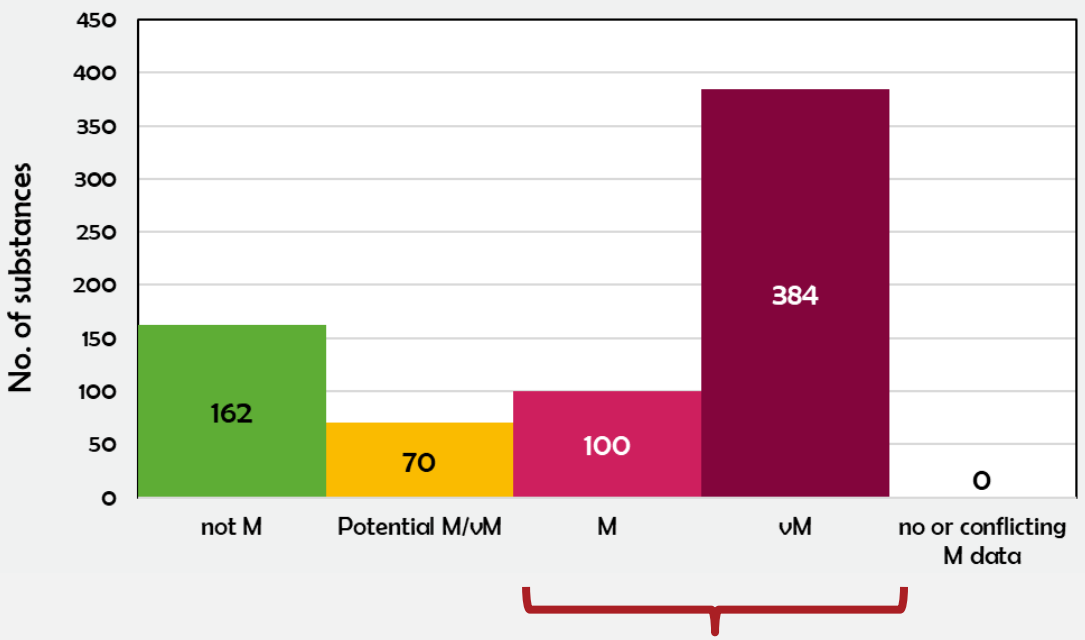
$$K_{OC} = \frac{C_{soil\ OC}}{C_{water}}$$



Mobility, results

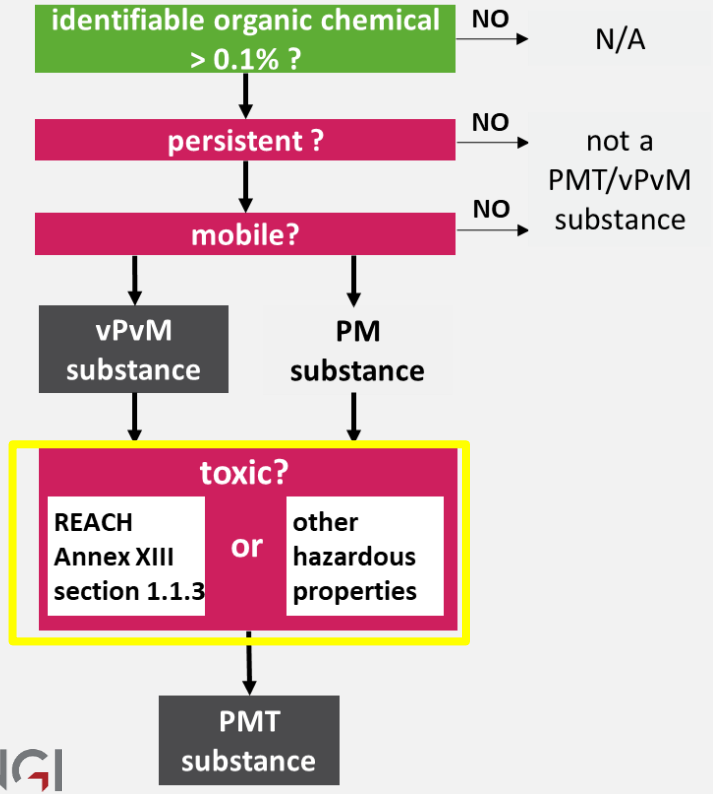


Starting with 716 substances



484 of substances proceed to the «toxicity» step

Assessing Toxicity



T criteria identical to Annex XIII to the REACH Regulation, though with additions

A substance fulfils the toxicity criterion (T) in any of the following situations:

a) Long term NOEC/EC10 for marine/freshwater organisms < 0.01 mg/L

b) Carcinogenic (category 1A, 1B or 2); germ cell mutagenic (category 1A, 1B or 2); toxic for reproduction (category 1A, 1B or 2).

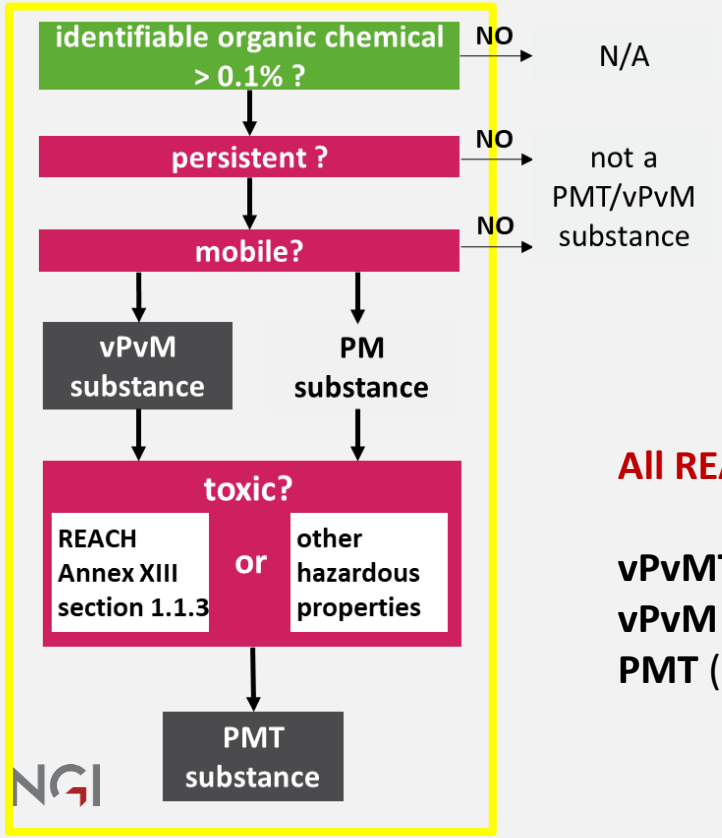
c) Specific target organ toxicity after repeated exposure (STOT RE category 1 or 2)

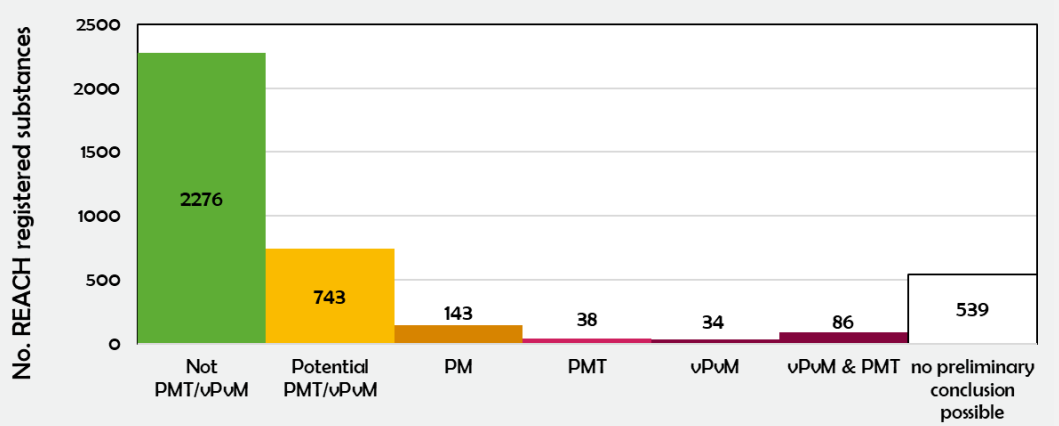
d) effects on or via lactation

e) Derived-No-Adverse-Effect-Level (DNEL) is ≤ 9 µg/kg/d (oral, long term, general population

f) endocrine disruption

PMT/vPvM assessment results





All REACH (2017)

vPvMT (155 substances)
vPvM (47 substances)
PMT (152 substances)

Excluding Article 14 exemptions

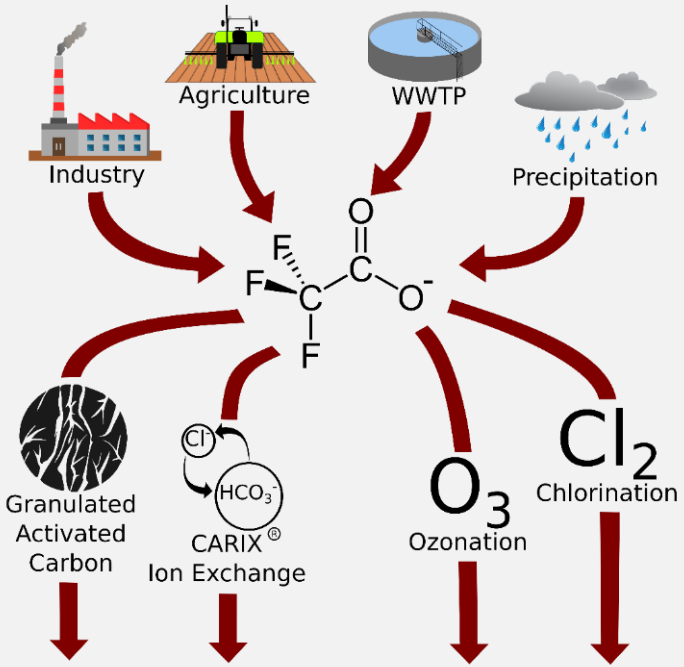
vPvMT (86 substances)
vPvM (34 substances)
PMT (38 substances)

NB: under REACH article 14, substances used as intermediates or produced at < 10 tpa are exempted from PBT assessment

Hot PMT/vPvM substances

- Ever increasing number of PMT/vPvM substances
  - GenX
  - PFBS
  - 1,4-dioxane
  - Trifluoroacetic acid

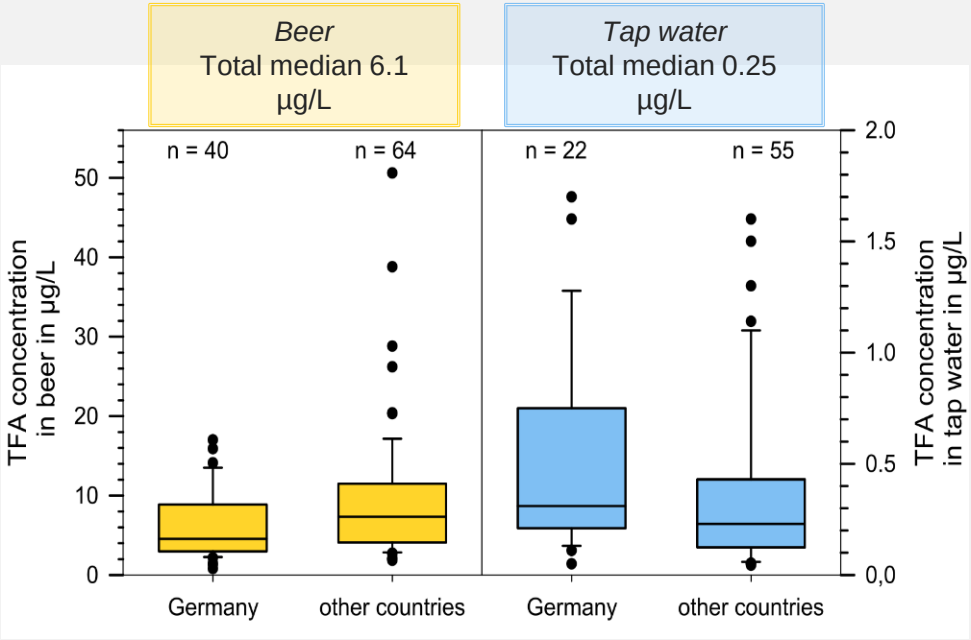
Trifluoracetic acid (TFA)



- vPvM substance
- Ubiquitous
- Arises from primary and secondary sources
- Isnt removed during drinking water treatment
- PFAS?

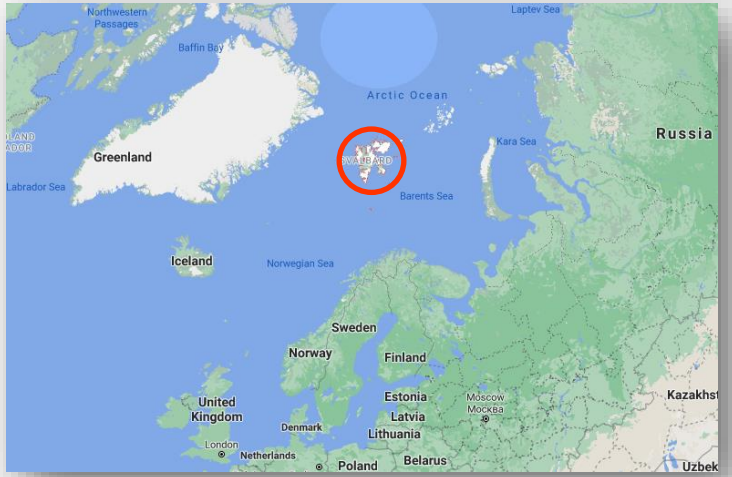
Figure: Karsten Nödler, TZW: DVGW-Technologiezentrum Wasser

Concentrations of TFA in diverse matrices



- Beer and tap water
- Human blood: 8.5 µg/L *(n = 252)*
- Human urine: ~10 µg/L *(n = 1)*
- Manure: ~100 µg/L *(n = 2)*
- Surface snow 0.06 µg/L *(n = 2)*

EURL-SRM – Residue Findings Report (2017), Duan et al. (2020), Environ. Int. 134, 105295, Nödler et al. (2019), https://www.nlwkn.niedersachsen.de/download/141156, Scheurer & Nödler (2021) Food Chem. 351, 129304.



Figures: Karsten Nödler, TZW: DVGW-Technologiezentrum Wasser

Analysis of PMT/vPvM substances

- Large span of log D_{OW}
- Liquid phase separation techniques
- Not always common place
- But possible
- Gap within monitoring requirements?

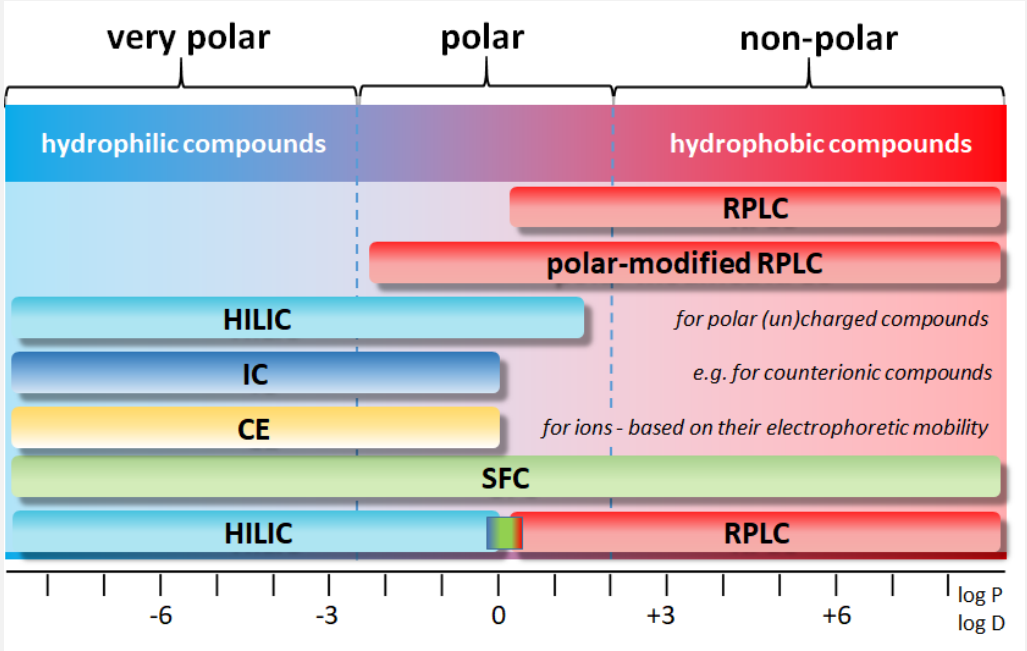


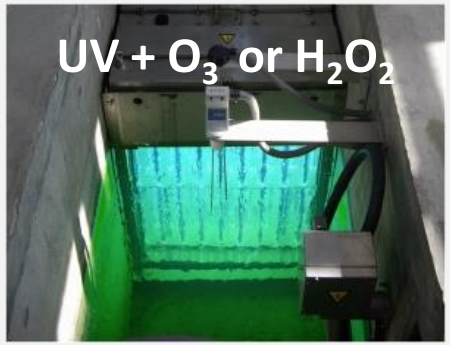
Figure: Thomas Letzel - AFIN-TS GmbH (Analytisches Forschungs(Research)institut für Non-Target Screening)

S. Bieber et al. 2017, *Analytical Chemistry*, *89 (15)*, 7907-7914. S. Bieber and T. Letzel 2018, LCGC Europe 31 (11), 602-608. S. Bieber and T. Letzel 2020, AFIN-TS Forum (1), 1-10.

Remediation of PMT/vPvM substances

- 59% of Europe used either non-treated drinking water or drinking water treated with natural treatment methods and conventional technologies.
- Only 41% used advanced water treatment technologies, such as granular-activated-carbon (GAC) filtration, ultrafiltration, advanced oxidation processes (like ozonation) and reverse osmosis.

progressivewater.com

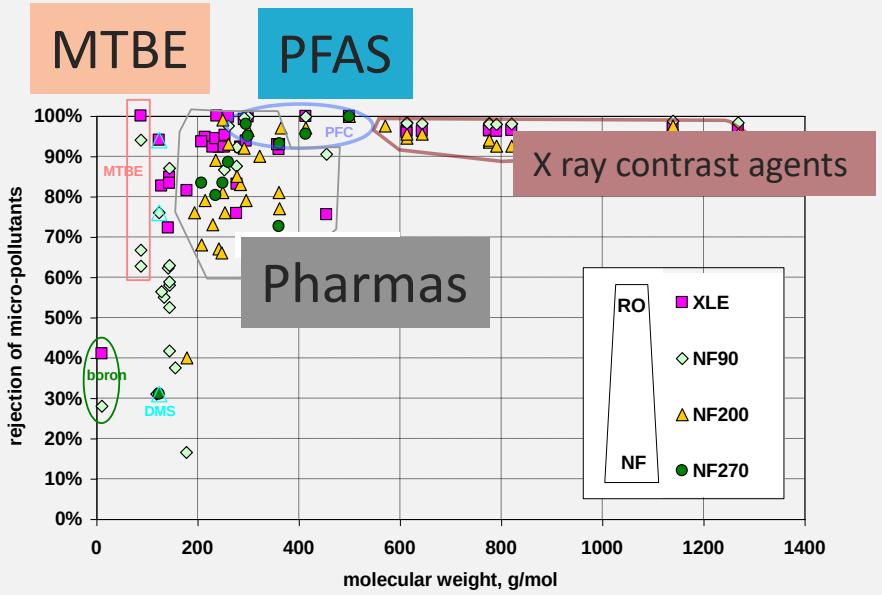


ecotechnologies.co.nz

Reverse osmosis (left) and advanced oxidation (right)

Remediation of PMT/vPvM substances

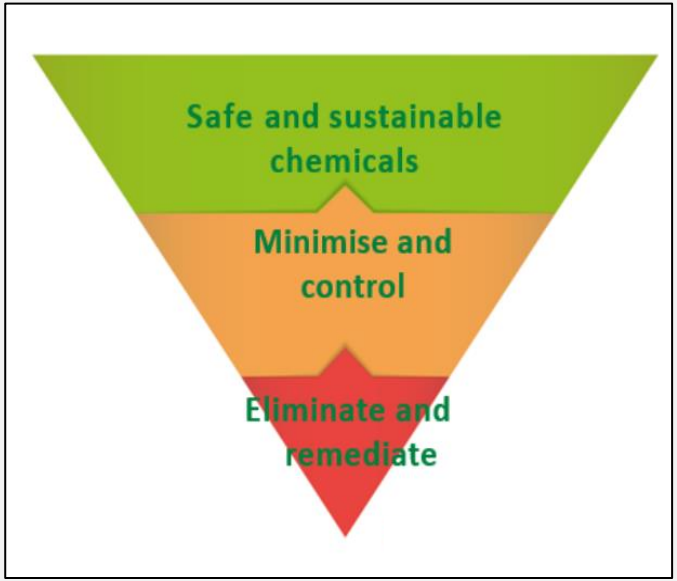
- Difficult/impossible to remove during conventional drinking water treatment
  - Biological treatment does not work for P
  - AC filtration does not work for M



RO – reverse osmosis

NF – nanofiltration

Chemicals Strategy for Sustainability towards a toxic free environment



Governance, stewardship and policy of PMT/vPvM substances

- Many building blocks are in place

TFEU 191 (2) Precautionary principle, polluter pays principle, control at source	European Green Deal: Chemicals strategy, Zero-pollution ambition, PFAS action plan	REACH: restriction for non-essential PFAS, definition essential uses, Art. 57 add PMT/vPvM to Svhc
PPP: Art. 44 re-assessment of active substances not achieving WFD objectives	CLP: introduce new hazard classes for PMT/vPvM substances, apply them across all legislation	WFD: GWD: PFAS as a class EQS: inclusion of PFAS total
Industry emissions Directive: Address emissions & reporting from industrial plants	E-PRTR: Address emissions & reporting from industrial plants	DWD: Article 7/8 Risk assessment & risk management Annex I PFAS total/Sum

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PMT/vPvM substances in the CLP and REACH

CLP:
introduce new hazard classes for PMT/vPvM substances, apply them across all legislation

- CLP - introduce new hazard classes for PMT/vPvM substances
  - Cut off values?

- Adapt legal text in REACH to include PMT/vPvM substances as SVHC under article 57

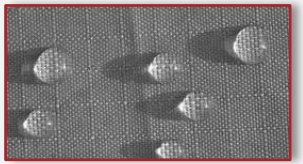
REACH:
Art. 57 add PMT/vPvM to SVHC, restriction for non-essential PFAS, definition of essential use,

CIRCABC - Welcome (europa.eu)

PMT/vPvM substances in REACH

REACH:
Art. 57 add PMT/vPvM to SVHC, restriction for non-essential PFAS, definition of essential use,

- Broad PFAS restriction (2025)



Essential

Medical protective clothing

Non-essential

Ski wax

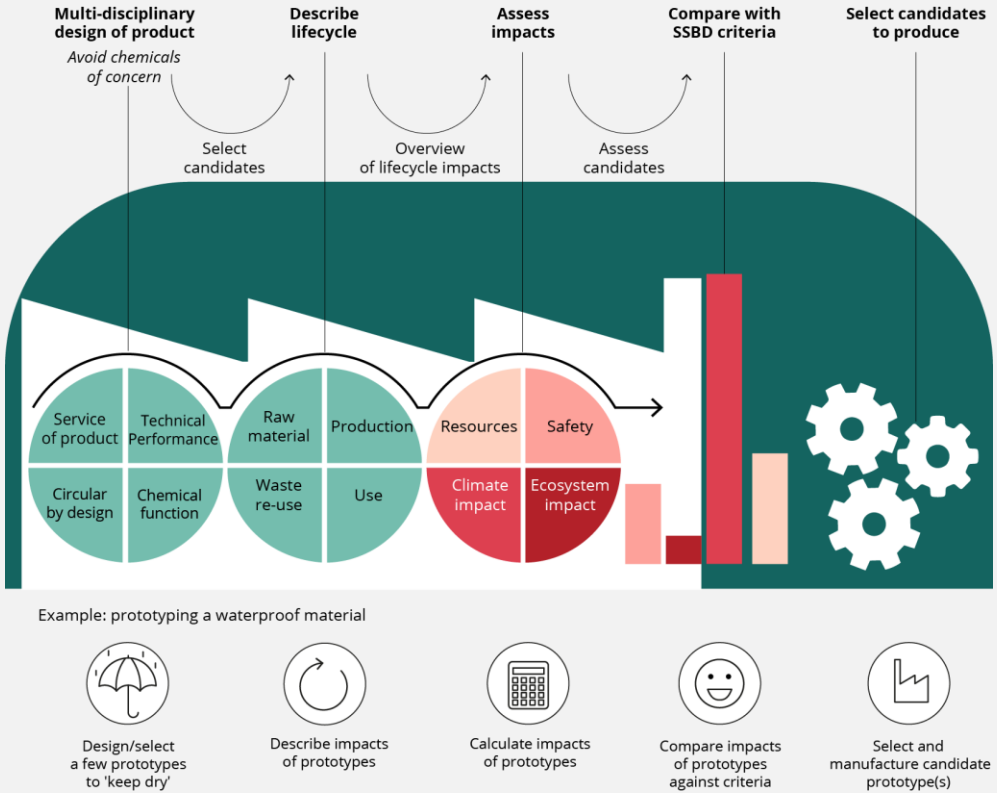
Cosmetics

- Definition of essential use for PFAS

?

Safe and Sustainable by design for PMT/vPvM substances

- Prevent pollution from PMT/vPvM substances at the very start
- Substitution (but not regrettable)

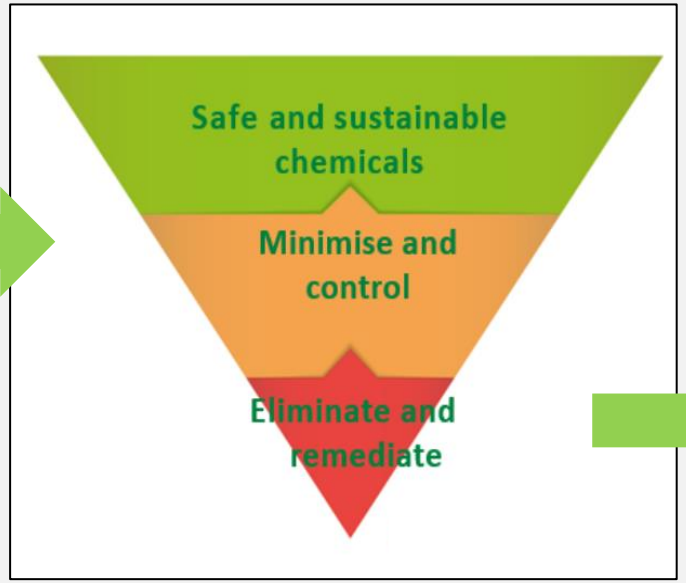


EEA briefing 2021: Delivering chemicals and products that are safe and sustainable by design. https://www.eea.europa.eu/highlights/designing-safe-and-sustainable-products

Conclusion and looking towards the future

PMT/vPvM substances present a hazard for drinking water resources

Using scientific developments, proper risk governance and stewardship measures we can limit harm

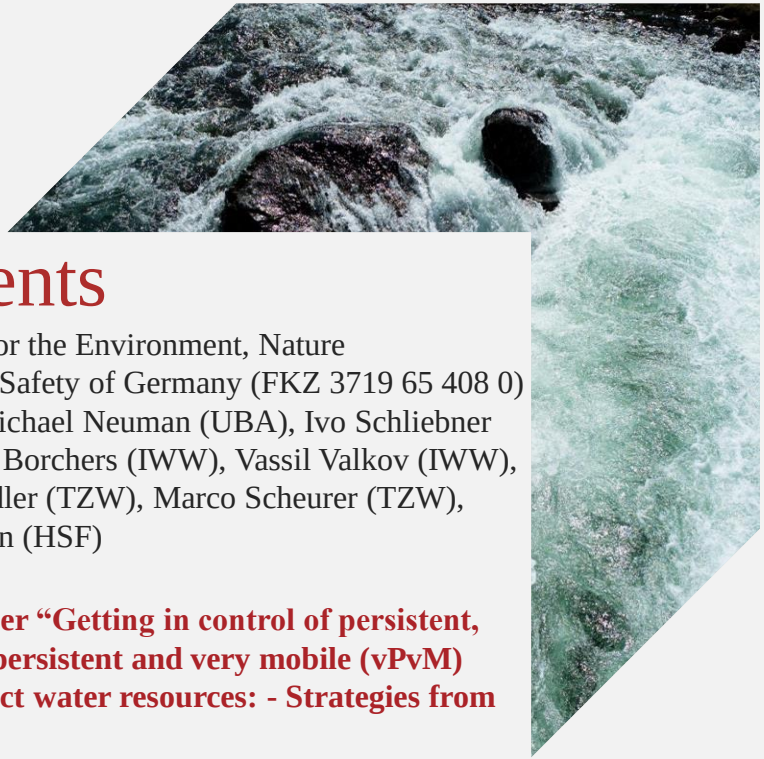


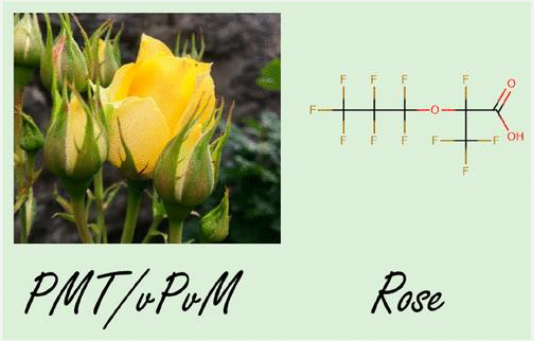
Upstream prevention is most effective to avoid harm

Zero pollution of PMT/vPvM substances

@ZeroPM_H2020

Funded by the European Union Horizon 2020 research and innovation programme under grant agreement No 101036756





Hale et al. *Environ. Sci. Technol.* 2020, 54, 23, 14790–14792

Acknowledgments

Funding from the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety of Germany (FKZ 3719 65 408 0)
Thanks to: Hans Peter Arp (NGI), Michael Neuman (UBA), Ivo Schliebner (UBA), Jona Schulze (UBA), Ulrich Borchers (IWW), Vassil Valkov (IWW), Laura Wiegand (IWW), Karsten Nödler (TZW), Marco Scheurer (TZW), Isabelle Neuwald (HSF), Daniel Zahn (HSF)

Coauthors on the forthcoming paper “Getting in control of persistent, mobile and toxic (PMT) and very persistent and very mobile (vPvM) substances under REACH to protect water resources: - Strategies from diverse perspectives”

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#påsikkergrunn

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