EUSBSR
EU STRATEGY
FOR THE BALTIC
SEA REGION

Closing the loop – sustainable and safe nutrient recycling in the Baltic Sea Region

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Policy Area 'Hazards' - policy background

Linked to key priorities of 7th EU Environment Action Programme:

- **Protect nature** and strengthen **ecological resilience**
- Boost **resource efficiency and circular economy** by eliminating toxic chemicals in prodcuts
- Reduce threats to **human health** and well-being linked to pollution and chemical substances
- A **non-toxic environment**
- Contribution to EU Marine & Coastal Policy and integtegrated Maritime Policy
- **Helcom BSAP**

HELCOM

Reducing the Impact of hazardous substances

ACTIONS

- **Prevent pollution** and **reduce use** of hazardous substances
- **Mitigate and remediate** contamination
- **Facilitate** implementation of regulatory frameworks and conventions
- **Promote** research and innovative management

Action areas are implemented through processes and activities led by PA Hazards coordinator and steering group, and Flagships

Funding


BONUS
SCIENCE FOR A BETTER FUTURE OF THE BALTIC SEA REGION


Interreg
EUROPEAN UNION

Policy Area Hazards projects and processes

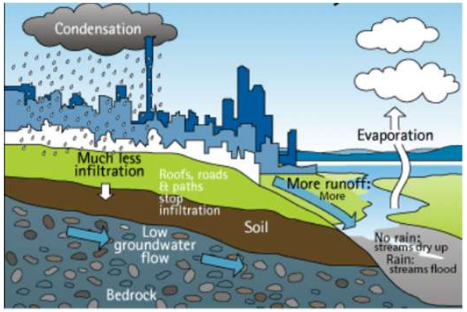
Reducing toxic antifouling paints on leisure boats (CHANGE)

Remediation of dumped chemical munitions (DAIMON)

Pharmaceuticals in BSR Environment (BSR Pharma platform)

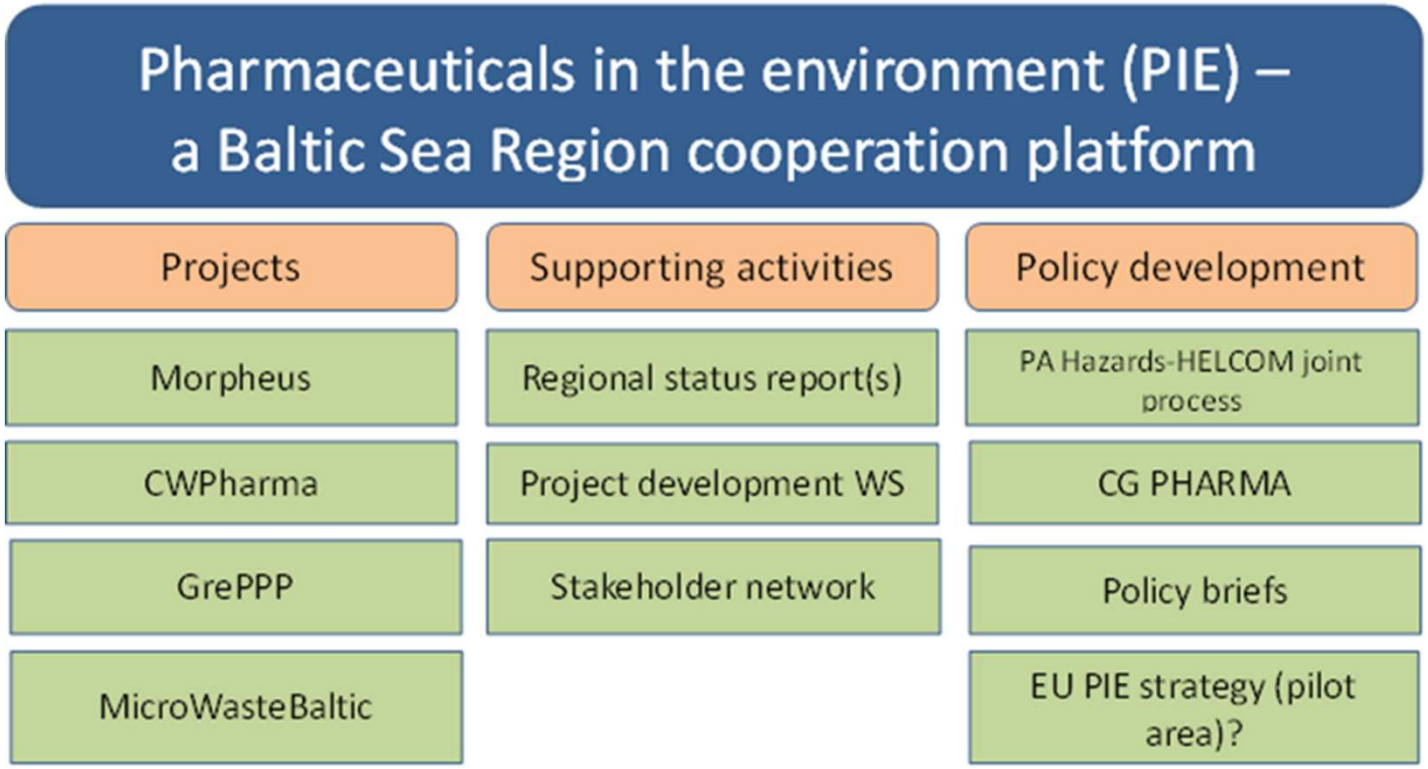
Sources of plastic waste to the Baltic Sea (BLASTIC)

Reduce urban emissions of hazardous substances (NonHazCity)



Hazardous industrial chemicals in the IED and BREFs (HazBref)

Baltic Sea Pharma Platform



Other areas of cooperation

- **Highly fluorinated substances (PFAS/ PFAA)**

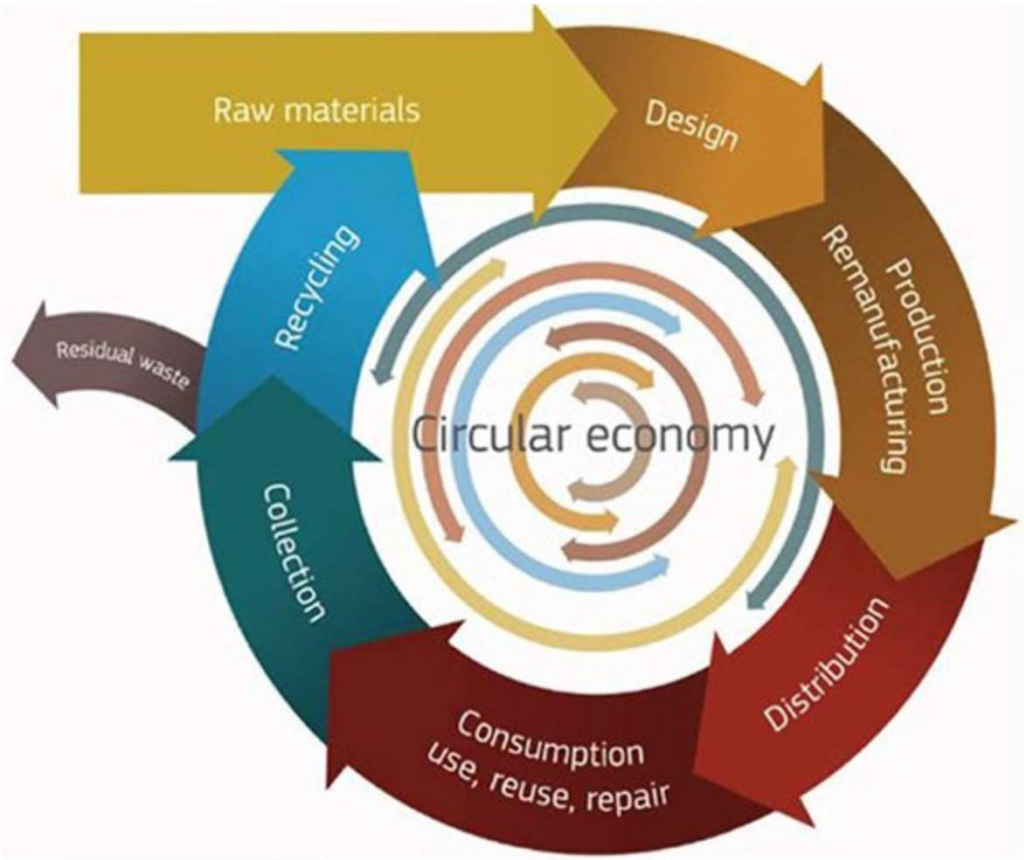
Action objectives: Increase the knowledge about effects and sources of specifically identified and emerging pollution problems relevant for the Baltic Sea, and support the development of innovative and cost-effective management options.

- **Micropollutants**

Action objectives: To develop and implement (non-)regulatory measures and Baltic Sea Region-wide policies to reduce the use and emissions of hazardous substances to the Baltic

  - **Antibiotics & AMR (ARBs) as part of BSR Pharma platform**

Towards a circular economy



Do you have a toilet at home?

Micropollutants in *effluents* of the WWTP identified by the HELCOM counties

Substance (group)	WWTP
Dioxins (PCDD, PCDF, dioxin-like PCBs)	3
Other PCBs (other than dioxin-like)	5
Organotin compounds (TBT, TPhT, etc)	6
PBDEs (pentaBDE, octaBDE, decaBDE)	4
PFAS (PFOS, PFOA)	8
HBCDD	4
Nonylphenols (NP, NPE)	12
Octylphenols (OP, OPE)	12
Short-chain chlorinated paraffins (C10-13)	5
Medium-chain chlorin. paraffins (C14-17)	3
Endosulfan	2
DDTs (sum-DDT, DDE, etc)	2
PAHs (incl. metabolites)	8
BFRs (PBDEs etc)	5
HCHs (alpha, beta, gamma)	4
Heptachlor	4
Heavy metals	14
Pharmaceutical residues	12
Herbicides (except listed above)	6
Fungicides (except listed above)	5
Insecticides (except listed above)	5
Endocrine disrupting substances (EDS, except listed above)	9
Animal/veterinary drug residues (except listed above)	2
Disinfectants (except listed above)	5

Source: Emma Undeman, Stockholm University, MicroWasteBaltic project, BSR Water Platform, revision of the Helcom BSAP on hazardous substances

Sewage sluge composition

- H2O
- H, S, F
- N & P, C (K, Mg)
- As, Pb, Cd, Cu, Hg, Zn

Table 2

Sewage sludge composition according to [DWA 387] and [OLIVA et al.]

Material	Unit	Value range according to DWA	Material	Unit	Value range according to DWA
pH value	–	7.7*	Chromium (Cr)	mg/kg (raw)	50–80
Total solids content (TS)	% by weight	30,5*	Copper (Cu)	mg/kg (raw)	300–350
Ignition loss (IL)	%	45–80**	Manganese (Mn)	mg/kg (raw)	600–1,500
Water	% by weight (raw)	65–75	Nickel (Ni)	mg/kg (raw)	30–35
Ash	% by weight (raw)	30–50	Selenium (Se)	mg/kg (raw)	1–5
Volatile components	% by weight (raw)	30	Thallium (Th)	mg/kg (raw)	0.2–0.5
Volatile components	% by weight (wf)	40–65	Vanadium (V)	mg/kg (raw)	10–100
Net calorific value (NCV)	MJ/kg (raw)	1–2/10–12***	Mercury (Hg)	mg/kg (raw)	0.3–2.5
Carbon (C) total	% by weight (waf)	33–50	Zinc (Zn)	mg/kg (raw)	100–300
Oxygen (O) total	% by weight (waf)	10–20	Tin (Sn)	mg/kg (raw)	30–80
Hydrogen (H) total	% by weight (waf)	3–4	AOX	mg/kg DS	200–400****
Nitrogen (N)	% by weight (waf)	2–6	PCDD/F	ng/kg TE	5–100****
Sulphur (S) organic	% by weight (waf)	0.5–1.5	PCB6	mg/kg DS	0.01–0.02****
Fluorine (F)	% by weight (raw)	approx. 0.01	PAH	mg/kg DS	1–50***
Chlorine (Cl)	% by weight (raw)	0.05–0.5	Molybdenum (Mo)	g/kg DS	3.9*
Phosphorus (P)	g/kg (raw)	2–55	Cobalt (Co)	g/kg DS	6.53*
Antimony (Sb)	mg/kg (raw)	5–30	Calcium (Ca)	g/kg DS	71*
Arsenic (As)	mg/kg (raw)	4–30	Potassium (K)	g/kg DS	2.63*
Lead (Pb)	mg/kg (raw)	70–100	Magnesium (Mg)	g/kg DS	9.17*
Cadmium (Cd)	mg/kg (raw)	1.5–4.5			

Notes: raw = reference to original substance in delivery condition; waf = water and ash free; wf = water free
* Figures stem from [OLIVA et al.]; Median, according to [BOUBELA et al.]
** Figures stem from [OLIVA et al.]; according to [IWA – TU Wien]
*** Figures for dry sludge > 85 % DS
**** Figures for European sewage sludge stem from [OLIVA et al.]; according to [FÜHRACKER/BURSCH]

SOURCES: [DWA 387] AND [OLIVA ET AL.]

Hazardous substances in *sludge* from WWTP

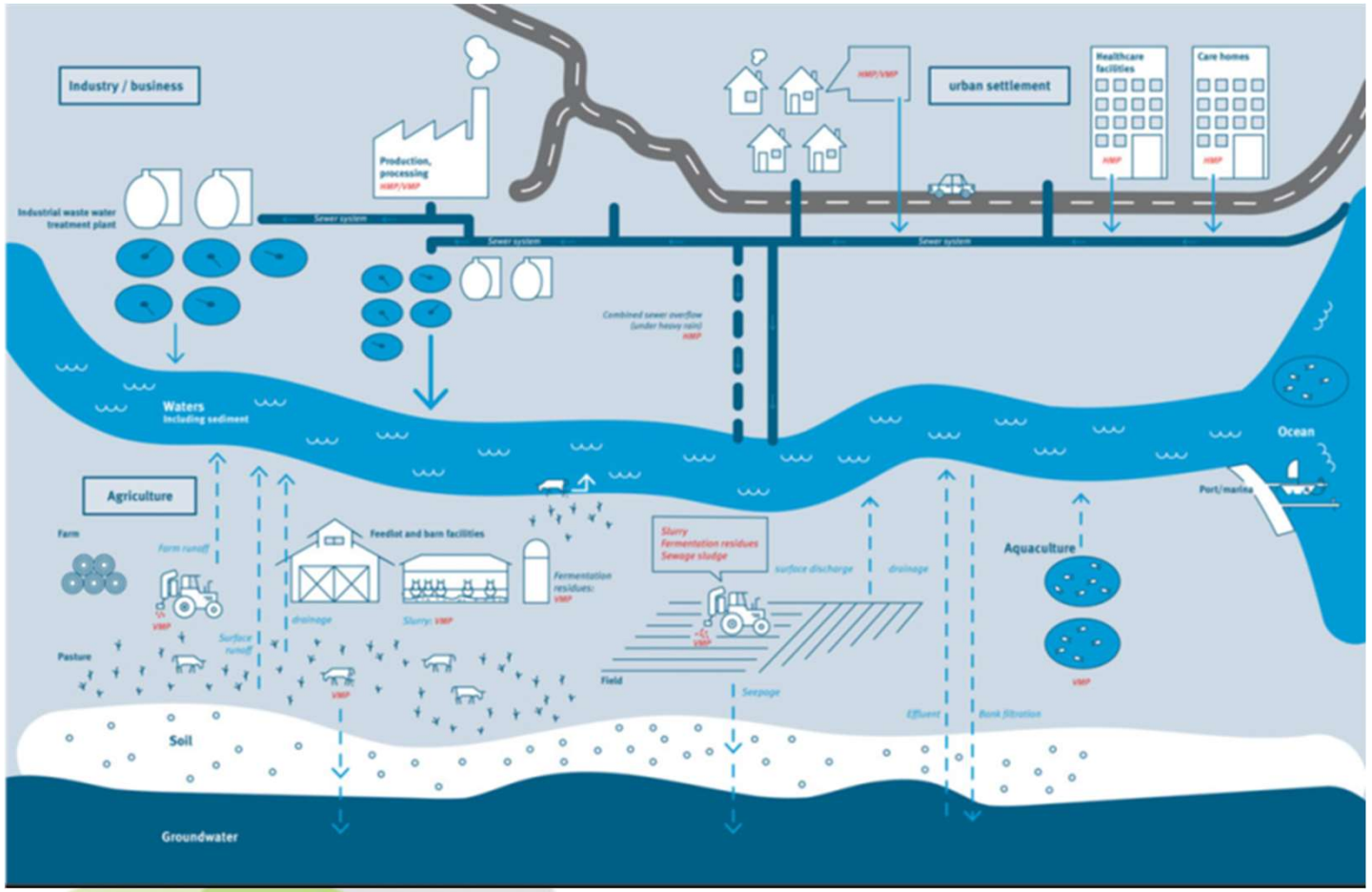
- Plastics
- Nano materials
- Pharmaceuticals
- Pathogens & ARBs
- Heavy metals
- PFAS (PFOS/ PFOA)
- PCBs
- Dioxins
- Desinfectants
- Cleaning agents
- Phenols

Concentrations of organic compounds in sewage sludge from North Rhine-Westphalia

Substance group	Organic pollutants	Average in [mg/kg DS]	90th percentile in [mg/kg DS]
Chlorophenols	Triclosan	3.4	5.5
Organotin compounds	Dibutyltin	0.22	0.35
	Dioctyltin	0.056	0.05
	Monobutyltin	0.17	0.32
	Monooctyltin	0.031	0.043
	Tetrabutyltin	0.0067	0.0025
	Tributylzinn	0.033	0.065
Polychlorinated dibenzodioxins and furans	PCDD/F I-TEQ	14 ng TE kg DR	22 ng TE kg DR
Polybrominated diphenyl	Tetrabromodiphenylether	0.026	0.037
	Pentabromodiphenylether	0.048	0.063
	Hexabromodiphenylether	0.011	0.011
	Heptabromodiphenylether	0.013	0.0058
PAH	Decabromodiphenylether	0.57	1.06
	Benzo(a)pyrene	0.47	0.73
	Chrysene	0.64	1.11
	PAH EPA (without acenaphthylene)	6.64	9.52
Polychlorinated biphenyls	PCB6 sum	0.091	0.17
Phthalates	DEHP	27.5	57.5
	Dibutyl phthalate	0.55	1
Surfactants	LAS	1,723	4,000
	Nonylphenol	21.5	44.2

Source: [FRAGEMANN/BAROWSKI]

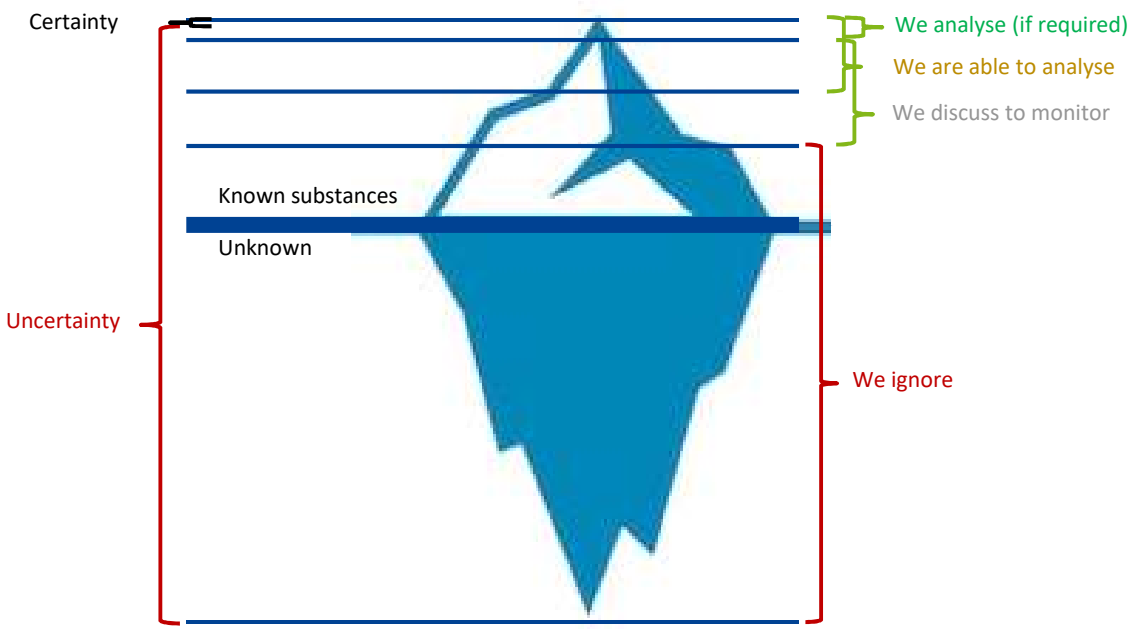
Entry points of ARBs to the environment



How do we define safety of a pollutant sink

like sewage (sludge), where contamination can be limited, but never excluded?

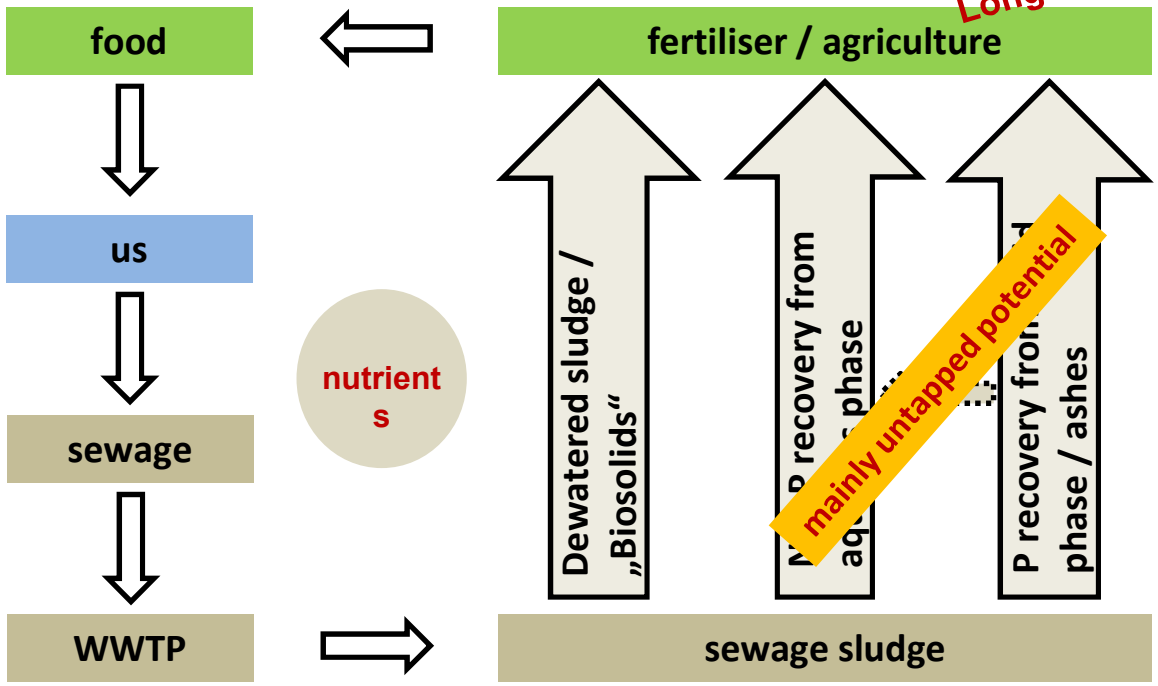
A drop of felt certainty vs. an ocean of uncertainty!



Monitoring contributes to increase certainty, but is unlikely to guarantee safety!
Where contamination cannot be excluded, effective and reliable **detoxification** of the material **is crucial** to provide safety!!!

Parameters in mg/kg DS	EU municipal sludge framework dir.	EU mineral fertilizer reg. draft 2016 PFC 1	STRUBIAS proposed PFC levels for inorg. macronut. fertiliser	Germany Fertiliser Ordinance	Germany Sludge Ordinance	US CFR 40 § 503/13	Japan
	1986	2016	2017	2017	2017		
Heavy Metals							
As - Arsenic	--	60	60	40	--	41	50
Tl - Thallium	--	--	--	1	--		
Cd - Cadmium	20 - 40	3	--	1.5	Fert. Ord.	39	5
Cd for P_2O_5 >5%	--	60-40 mg/kg P_2O_5	60-40-20 mg/kg P_2O_5	50 mg/kg P_2O_5	--	--	--
Cu - Copper	1000 - 1750	--	--	900	Fert. Ord.	1500	--
Hg - Mercury	16 - 25	2	--	1	Fert. Ord.	17	2
Ni - Nickel	300 - 400	120	120	80	Fert. Ord.	420	300
Pb - Lead	750 - 1200	150	150	150	Fert. Ord.	300	100
Se - Selenium	--	--	--	--	--	100	
Zn - Zinc	2500 - 4000	--	--	--	4000	2800	
Cr - Chromium (total)	--	--	--	--	Fert. Ord.	--	500
Cr - Chromium (VI)	--	2	2			--	--
Organic Contaminants							
PCB 28, 52, 101, 138, 153, 180 each	--	--	--	--	0.1	--	--
AOX	--	--	--	--	400	--	--
Benzo[a]pyrene	--	--	--	--	1	--	--
PAH_{16}	--	--	6?				--
PFC (PFOA + PFOS)	--	--	tbc	0.1	Fert. Ord.	0.1	--
I-TE Dioxines and dl PCB (WHO-TEQ 2005)	--	--	--	0.03	Fert. Ord.	0.03	--
Biuret ($C_2H_5N_3O_2$)	--	1200	--	--	--	--	--
Perchlorate (ClO_4^-)	--	1	--	--	--	--	--

Pillars of Nutrient Recovery & Recycling

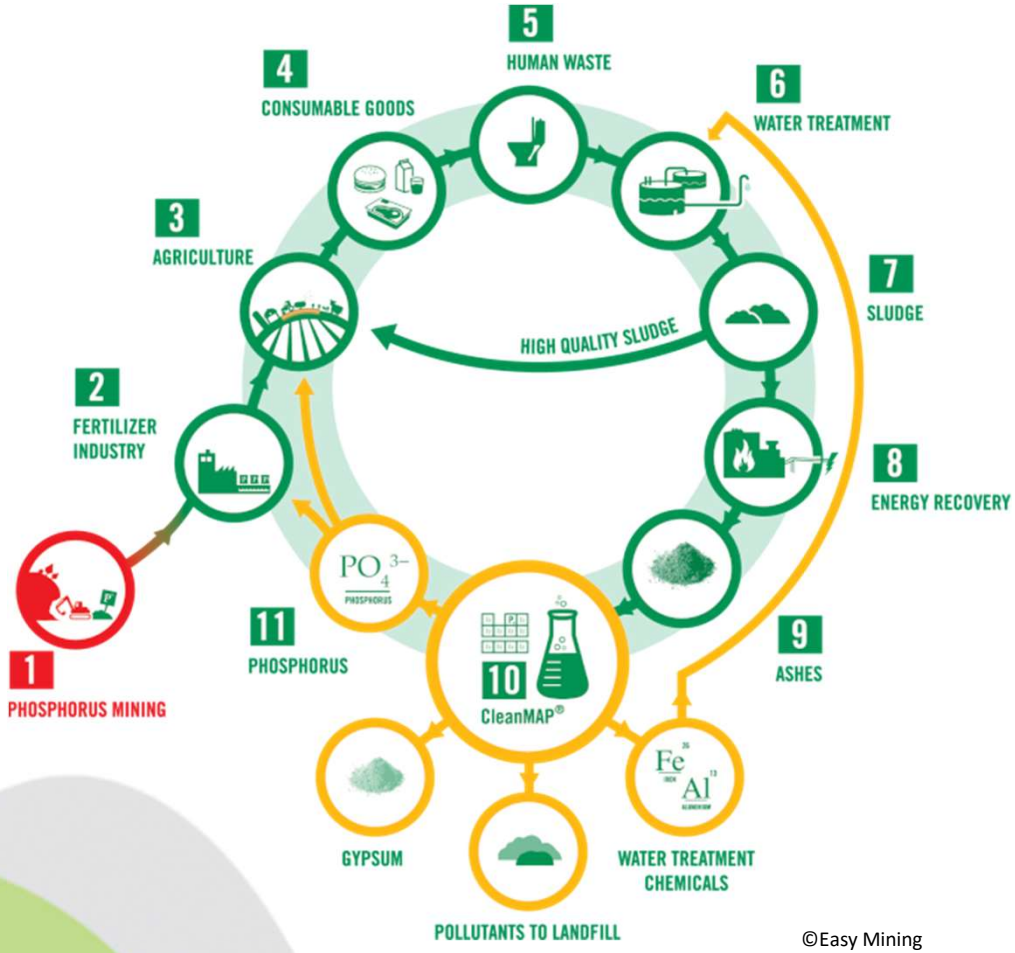


Long-term security for disposal
Concerns
Acceptance
Hygiene
Contaminants
Heterogenity
Uncertainties
Monitoring Cost
Surplus manure
Transparency

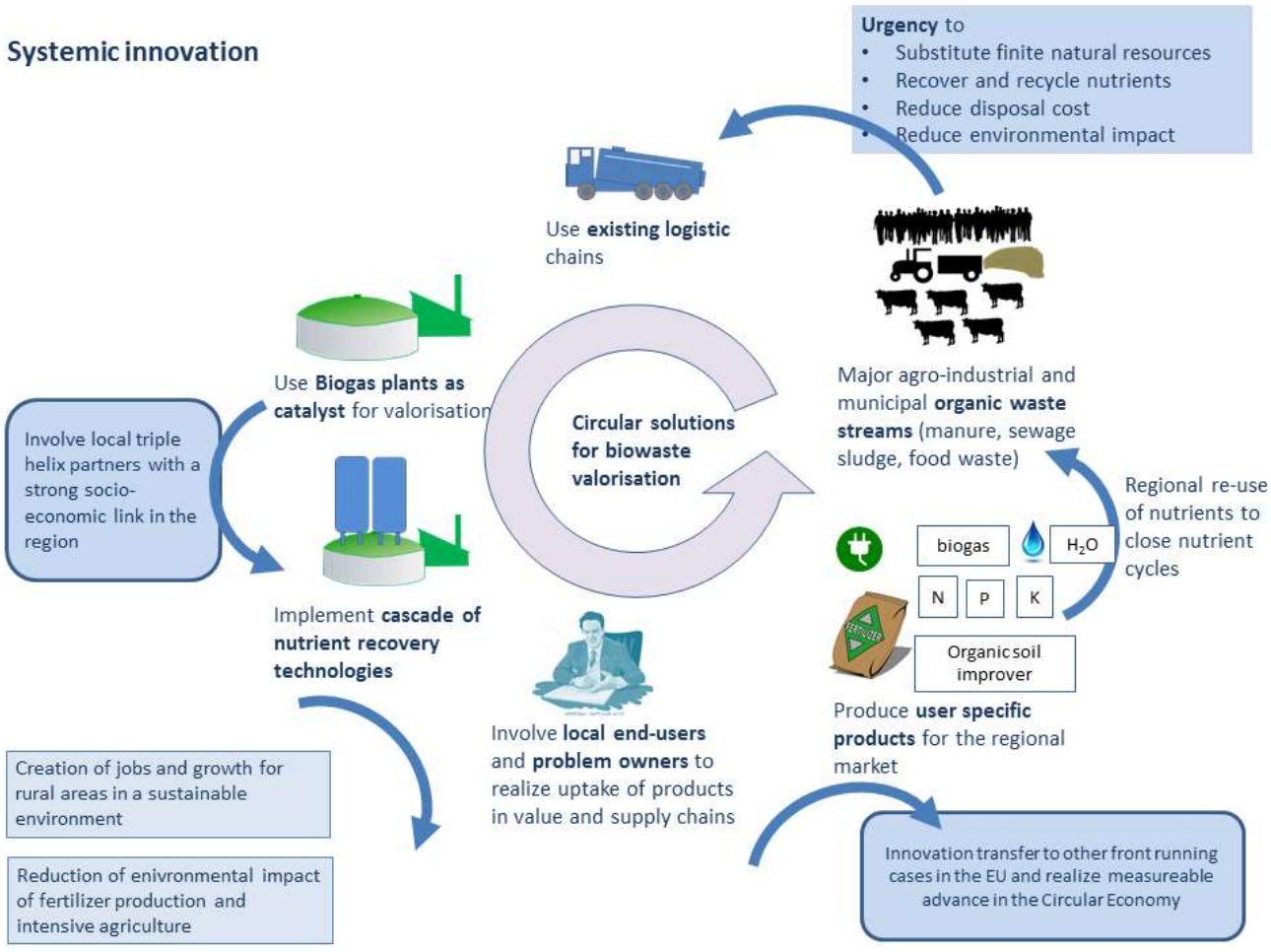
Challenge: Enabling techn. alternatives to complement /compensate traditional route!

Innovative circular solutions

Sustainable and safe nutrient recycling from sludge



From Waste to resource



Micropollutants in sludge

- Helcom regional strategy on nutrient recycling
- Safe and sutainable recycling of nutrients from WWTP sludge
- EU-workshop on best practices in P-recovery from sludge and legal ban of sludge spreading

TAIEX SHARING EU EXPERTISE SINCE 1996

TAIEX EU workshop: safe & sustainable P-recovery

Germany
Czech Republic
Switzerland
Austria
Netherlands
Finland
Norway
Denmark

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