

Waterboards on the way to recycle phosphorus

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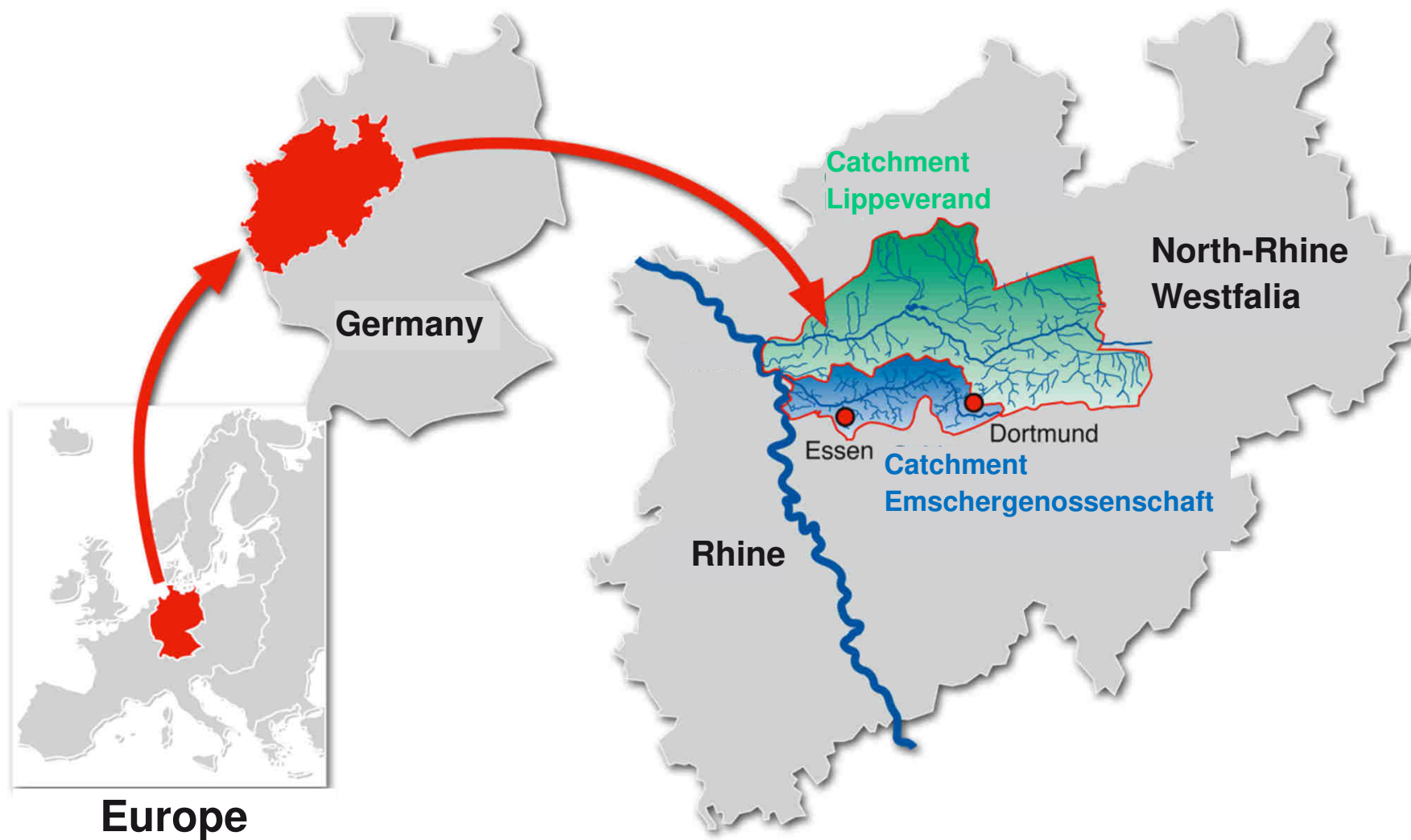
**Phosphorus - an
essential resource for all living
organisms**





Emschergenossenschaft/Lippeverband

Where we work

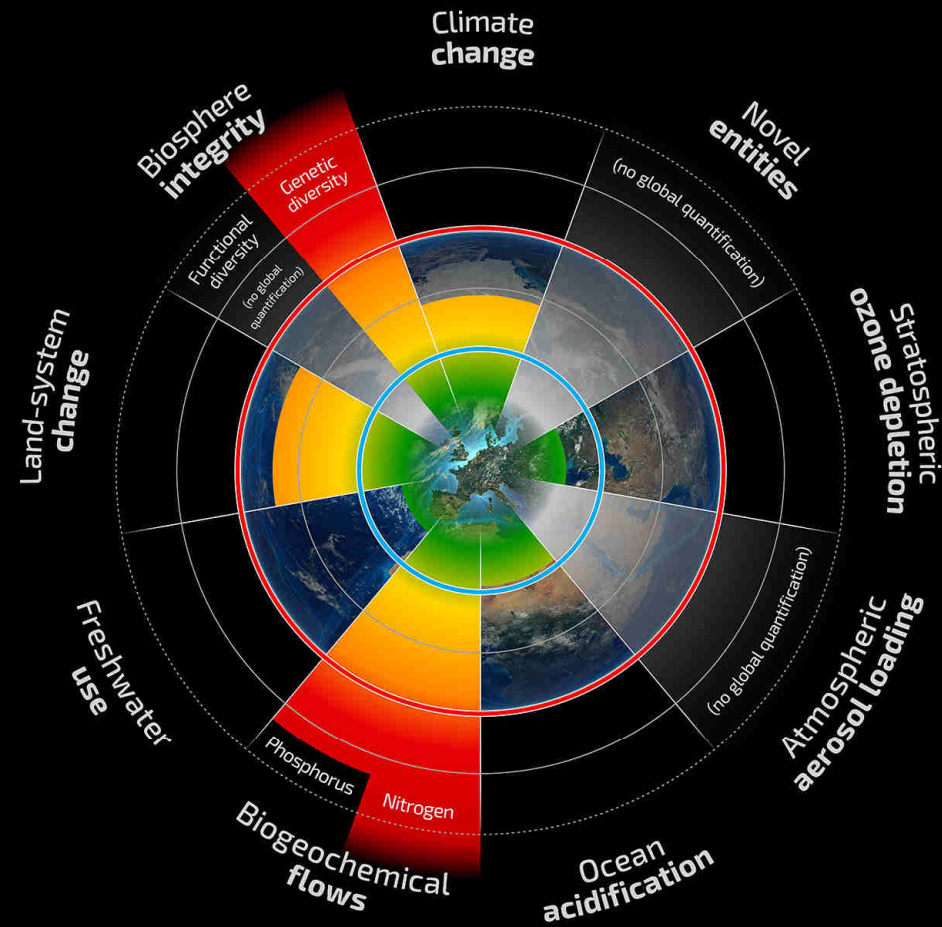


Content

- Reasons to engage in nutrient recovery for a public waterboard
- Phos4You gives EG/LV insights in phosphorus recovery technology
- Regional consideration for deployment of phosphorus recycling

Planetary Boundaries

A safe operating space for humanity



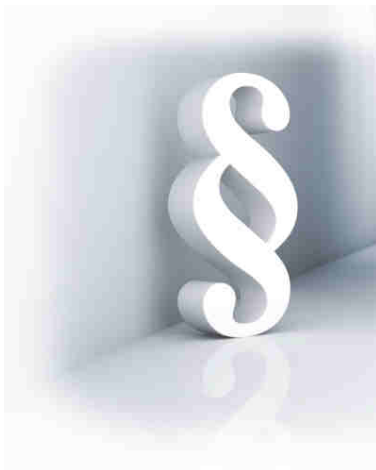
Waste water management deals intensively with the P & N flows!

- Beyond zone of uncertainty (high risk)
- In zone of uncertainty (increasing risk)
- Below boundary (safe)
- Boundary not yet quantified

Two public waterboards as an answer to societal challenge

Coal mining and industrialisation in the 19th century caused:

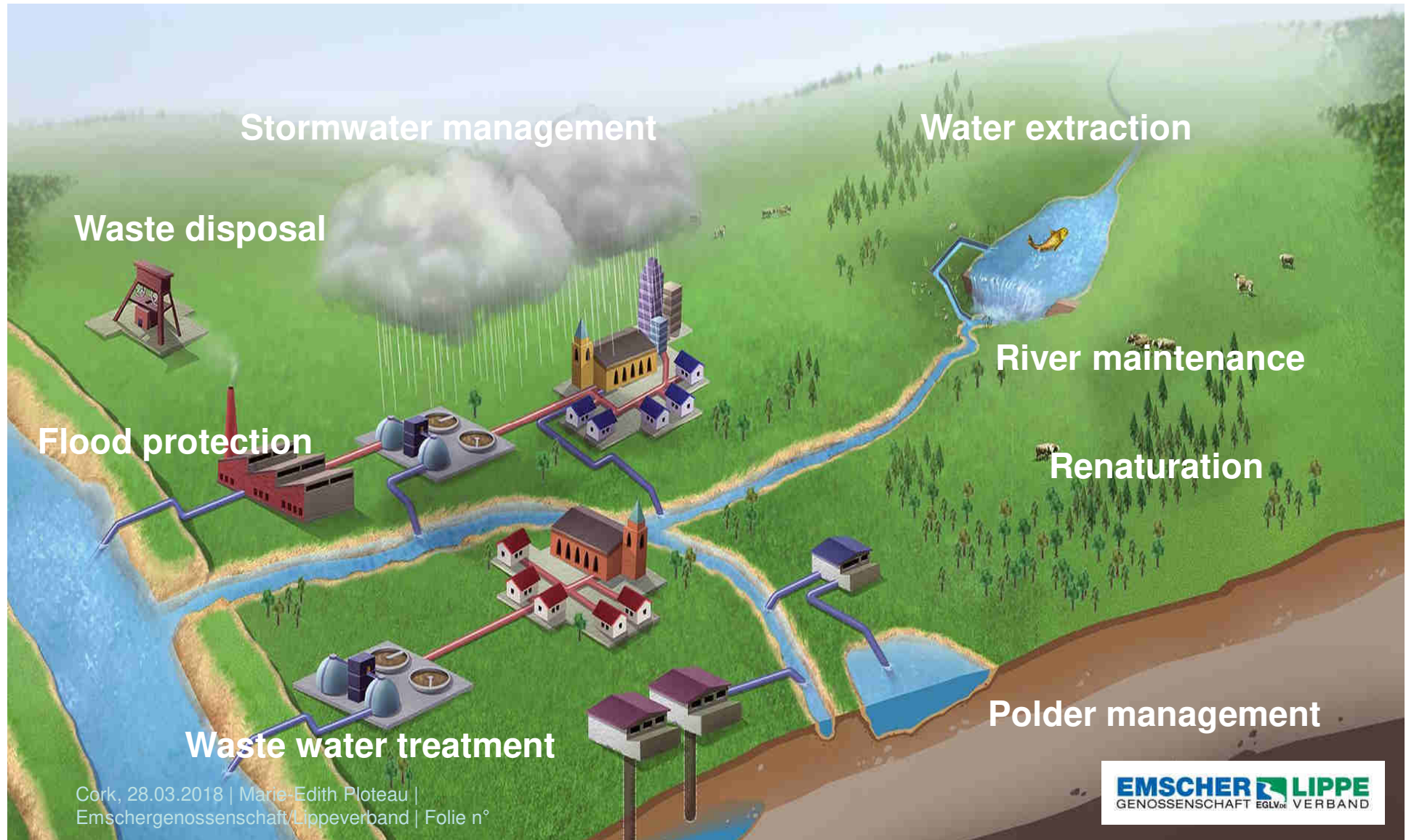
- subsidences
- pollution of the watercourses
- diseases, epidemic in the population



Formation of Emschergenossenschaft and Lippeverband:

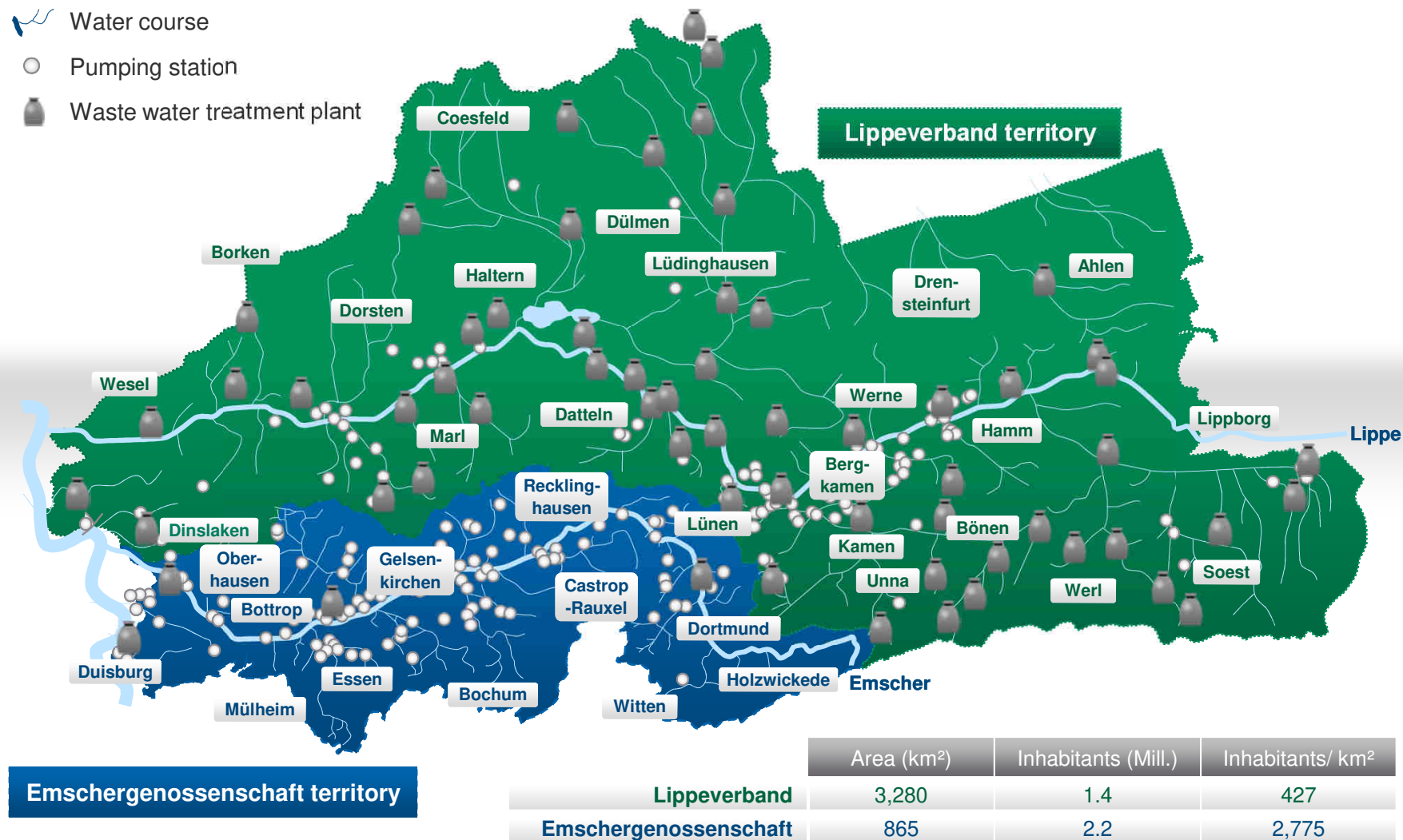
- Association of municipalities and industry;
- Mission: It is to serve the collective good of the public and the benefit of its members;
- Non-profit organisation;
- Now in charge of waste water treatment of 3,6 inhabitants

Task of EG/LV: Integrated water management for the complete water cycle



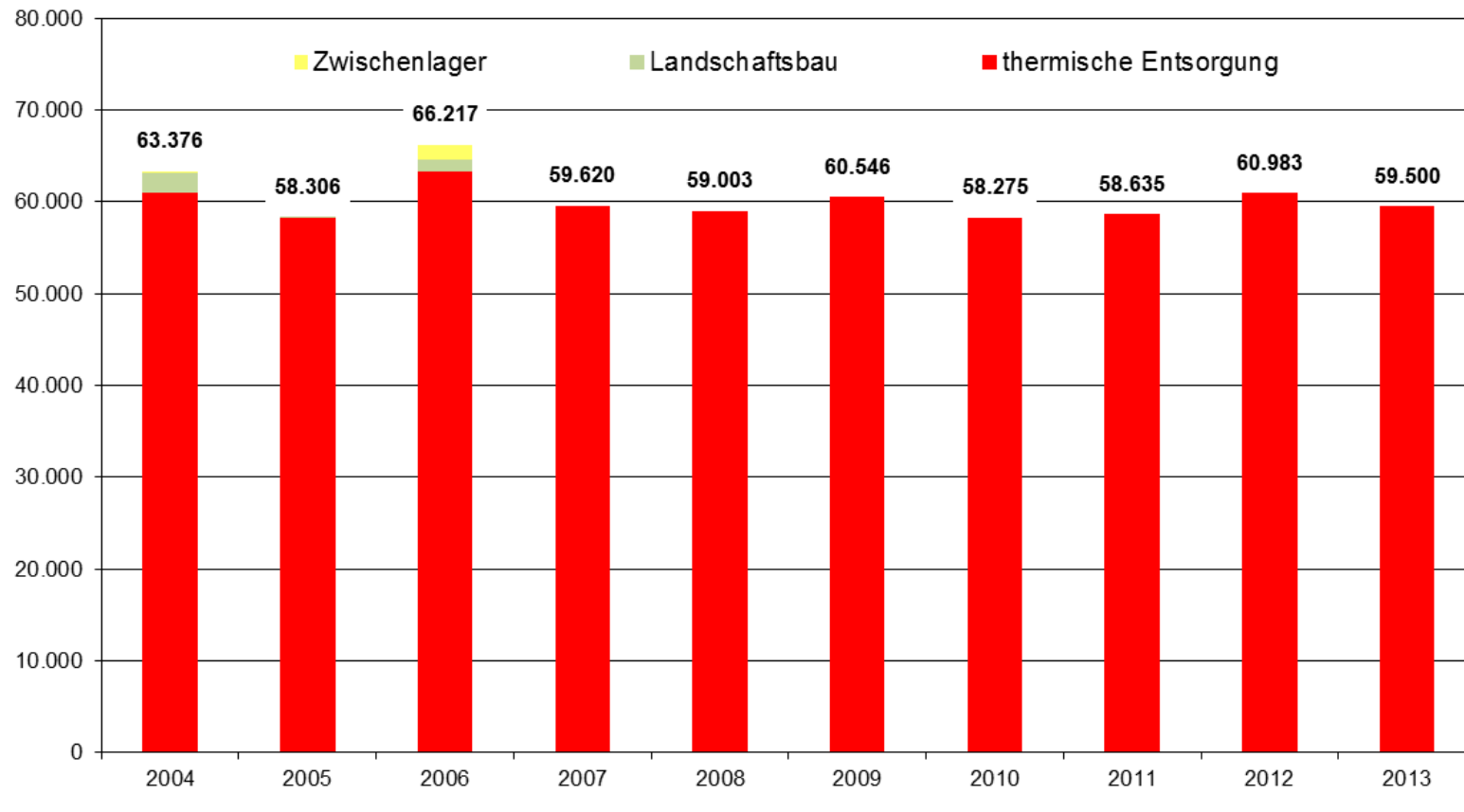
Our catchment areas

One of the biggest waste water disposal company in Germany



220,000 MgOS/a sludge disposed off by Emschergenossenschaft

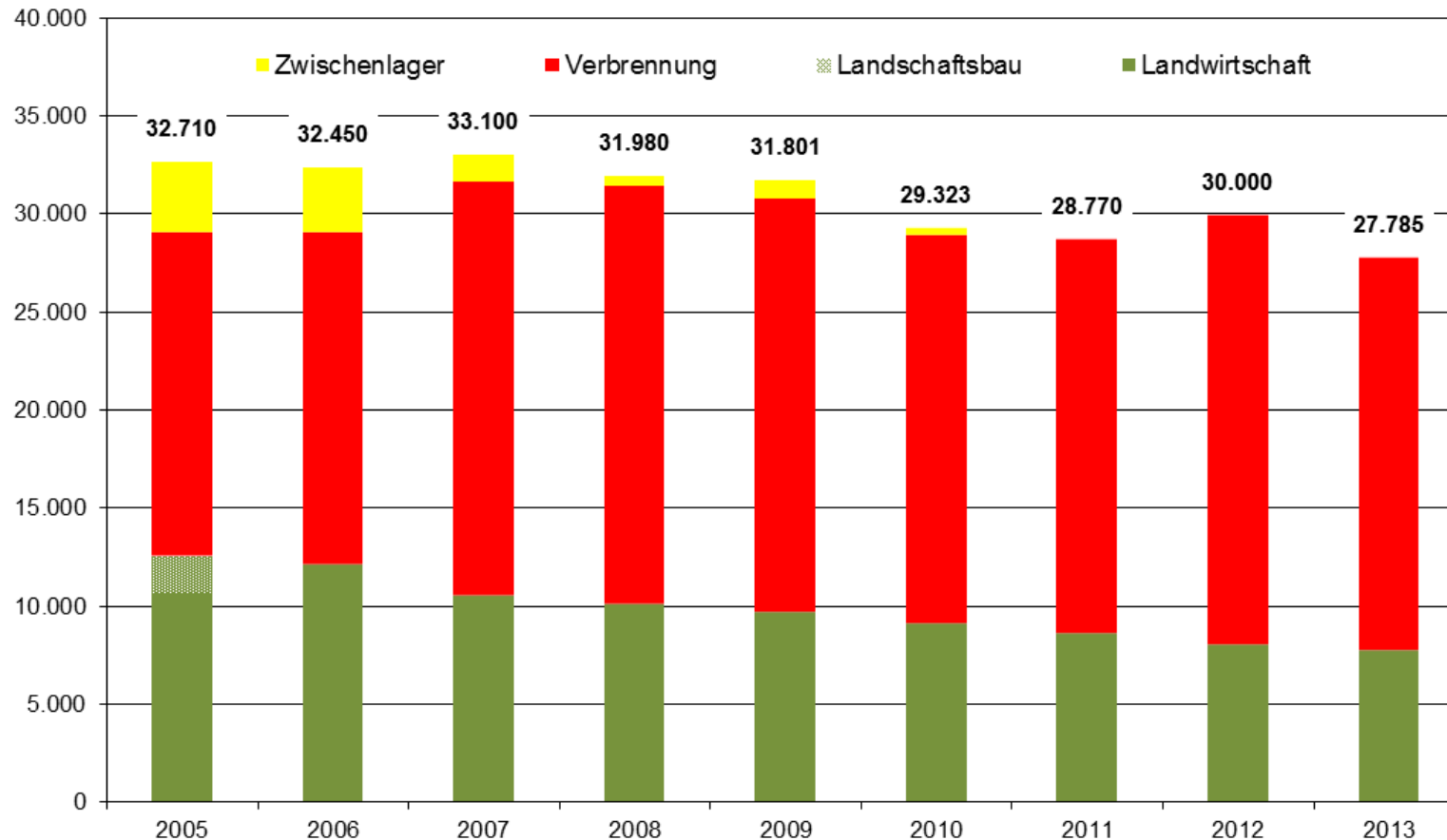
Klärschlammanfall / -entsorgung in MgSTS pro Jahr



100% incineration, of which 90% Mono incineration; 10% Cement industry

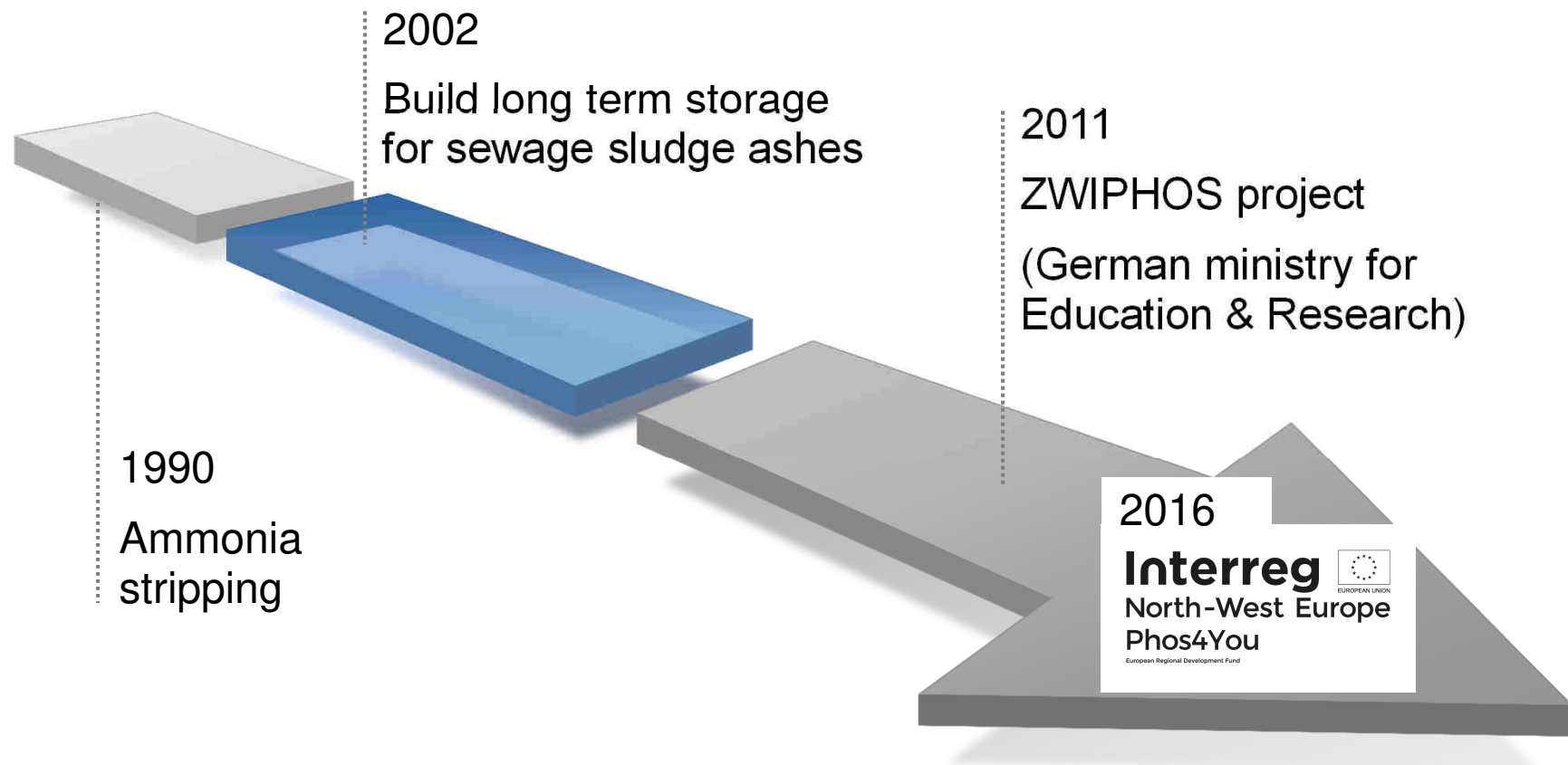
110,000 MgOS/a sludge disposed off by Lippeverband

Klärschlammanfall / -entsorgung in MgSTS pro Jahr



2016: 80% incineration, of which 45% Mono (Innovatherm); 55% Cement industry

Continuous commitment towards nutrient recovery



3 regulations amended 2017

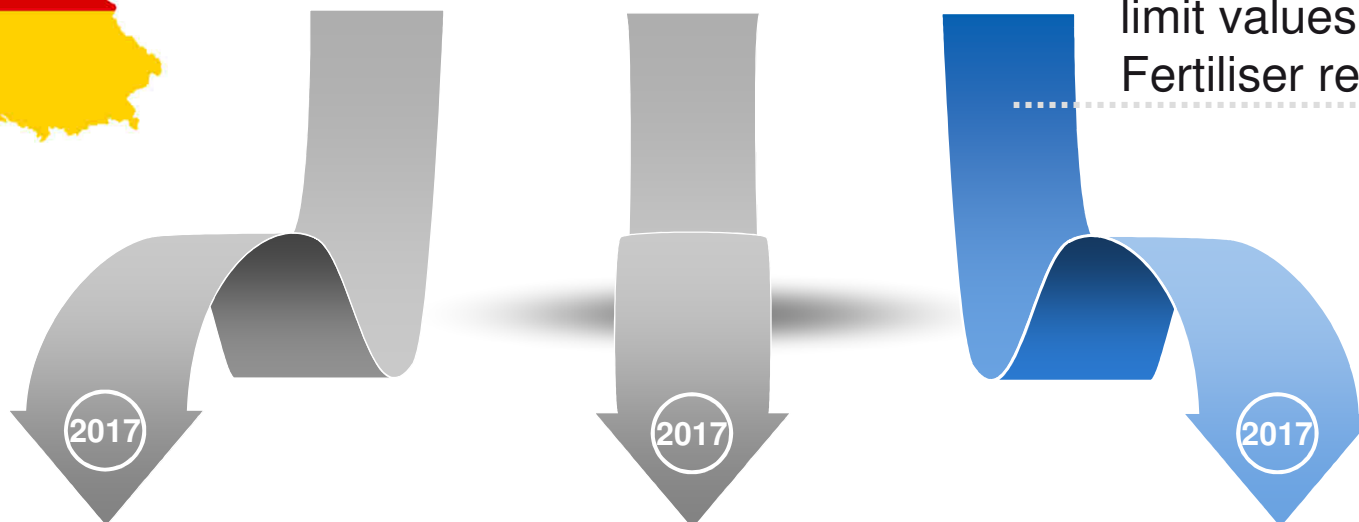


Fertiliser product
Regulation -
DüMV

Fertiliser
Regulation-
DüV

Sewage Sludge
Regulation
AbfKlärV

Amendment based on
limit values of
Fertiliser regulation



- Massive reduction of available land for sludge application (stronger limitation reg. Nitrogen & polymere)
- Prices increase for sludge incineration or land application
- Strategies for sludge disposal and phosphorus recovery are needed

New sewage sludge ordinance (3.10.2017) makes phosphorus recovery mandatory



Possible disposal pathway	wwtp > 100,000 PE from 2029 on	wwtp < 100,000 PE and > 50,000 PE from 2032 on	Wwtp < 50,000 PE
Land application	Prohibited		Permitted acc. fertiliser regulations
Co-incineration	Only if P-content < 20g/kg DM		
Mono-incineration with P-Recovery or SSA-disposal	If P-content > 20g/kg DM		

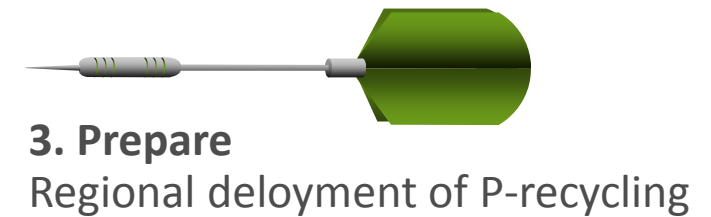
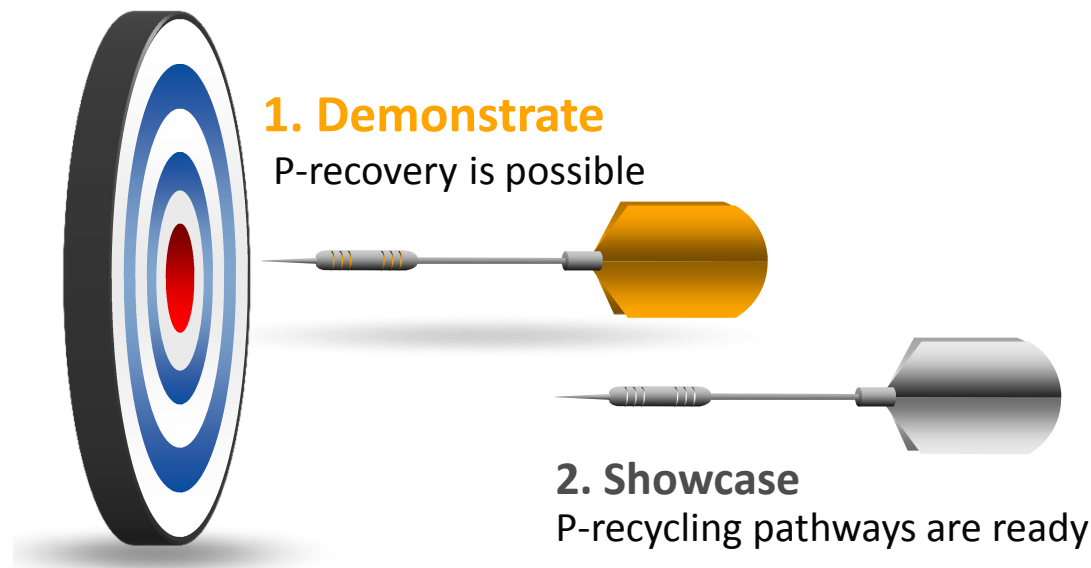
We cooperate to deliver phosphorus „made in Europe“



Objectives

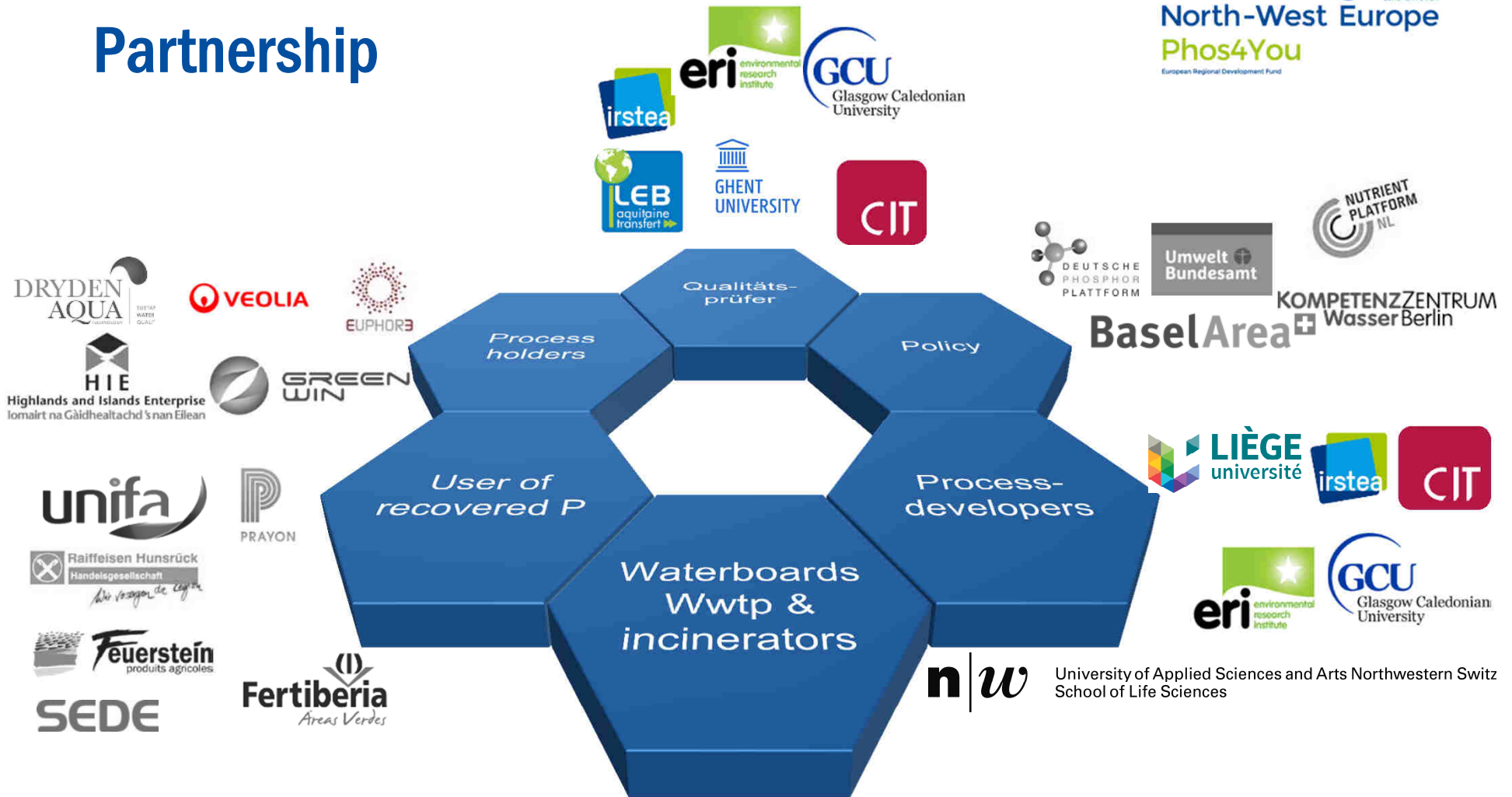
Key-Data

- 12 Partner from 6 EU-countries and CH
- 10,8 Mio. €
- 2016 - 2020
- 60% ERDF



Partnership

Interreg 
North-West Europe
Phos4You
European Regional Development Fund

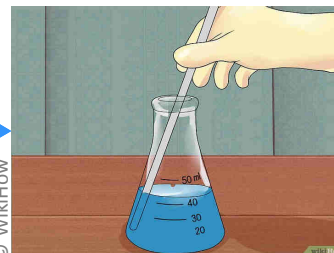


EG/LV looks at 3 pathways



© Emschergenossenschaft

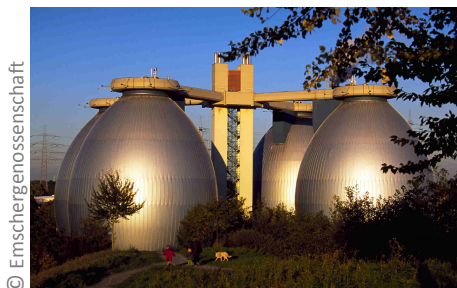
Sewage sludge ashes



© WikiHow

Phosphoric acid

Industrial application



© Emschergenossenschaft

Sewage Sludge



© EuPhoR

Phosphorus slag



Phosphate salts



© Lippeverband

Fertiliser

Co-incineration
(Cement industry, coal-fired power plant)

Acid extraction of phosphorus from sewage sludge ashes (SSA)

REMONDIS TetraPhos® process



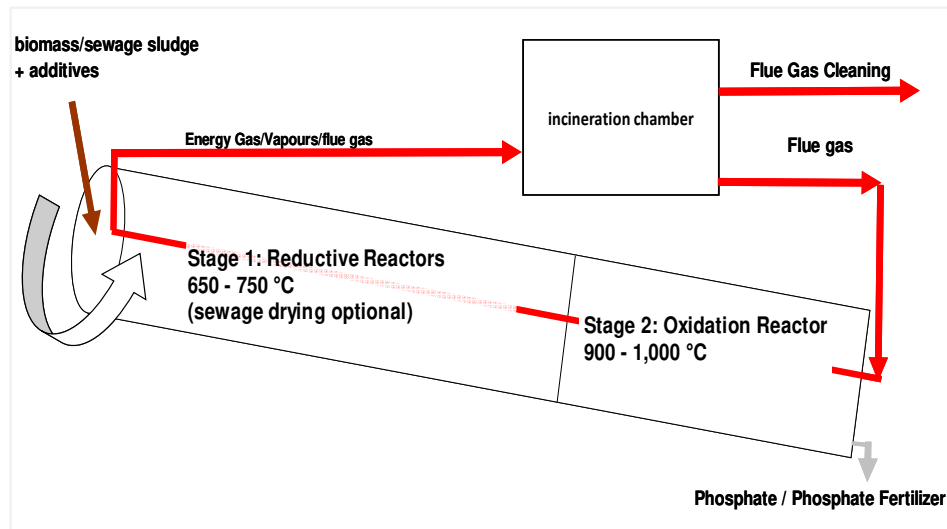
© Remondis Aqua

Demonstrator

- Location: sewage sludge incineration plant in Werdohl Germany
- Commissioning: May 2018
- Input material: SSA with low P-load
- Input mass: approx. 50 kg DM/h
- Output: H₃PO₄
- Output mass: approx. 18 kg/h

Thermochemical solution to recover phosphorus from sewage sludge

EuPhoRe® process



©EuPhoRe GmbH

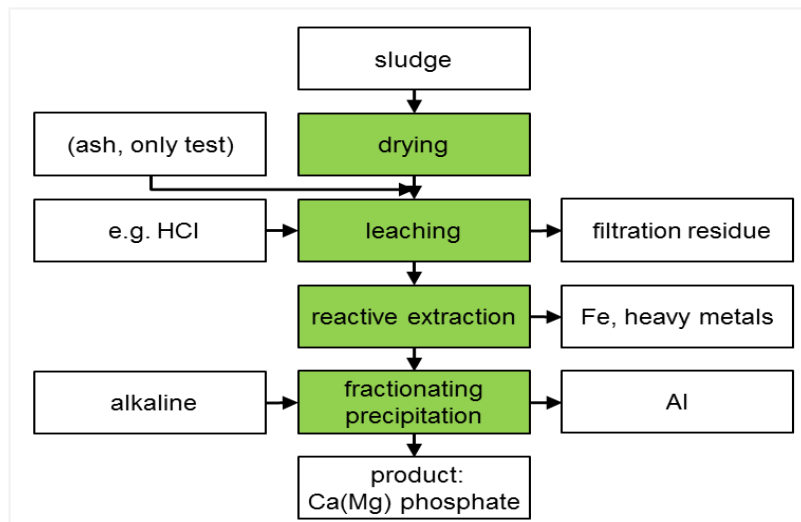
Demonstrator



- Location: Germany, Dinslaken
- Commissioning: Oct. 2018
- Input material: Sewage Sludge, 25 - 30 % Dry Matter (DM)
- Input mass: approx. 100 kg DM/h
- Output: Phosphate slag (12-20 % P₂O₅)
- Output mass: approx. 10 - 15 kg/h

Acid leaching of phosphorus from partially/fully dried sewage sludge

PULSe process



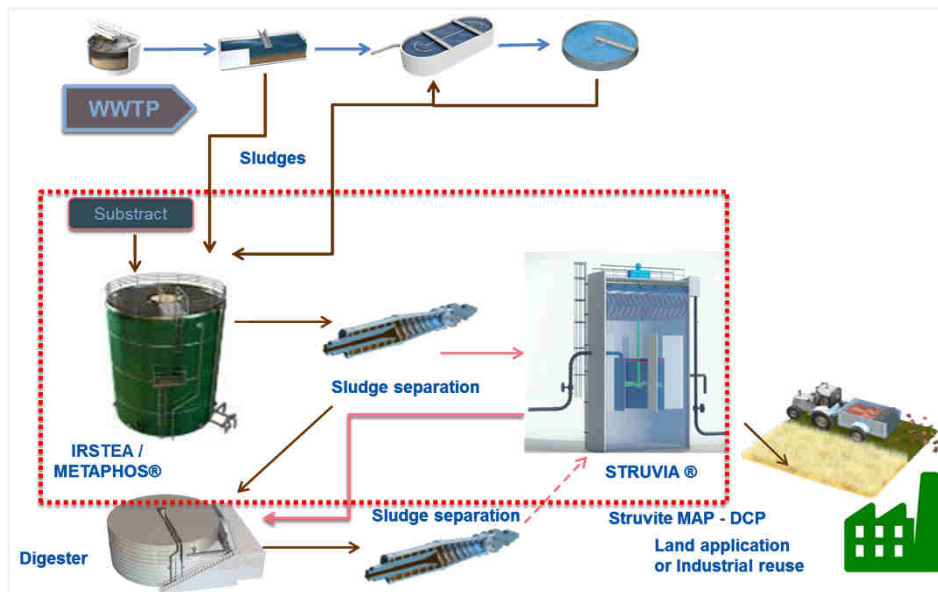
©University of Liège

Demonstrator

- Location: A mobile plant is used in by-pass at different WWTP in Belgium, Ireland, Scotland, Germany
- Commissioning: October 2018
- Input material: partially/fully dried sewage sludge (50 – 100 % DM)
- Input mass: approx. 100 kg OM/day
- Output: Ca/Mg/K Phosphate
- Output mass: approx. 1 kg/day

Biological phosphorus dissolution before P precipitation from sludge liquor

Improved STRUVIA process



©Véolia

Demonstrator

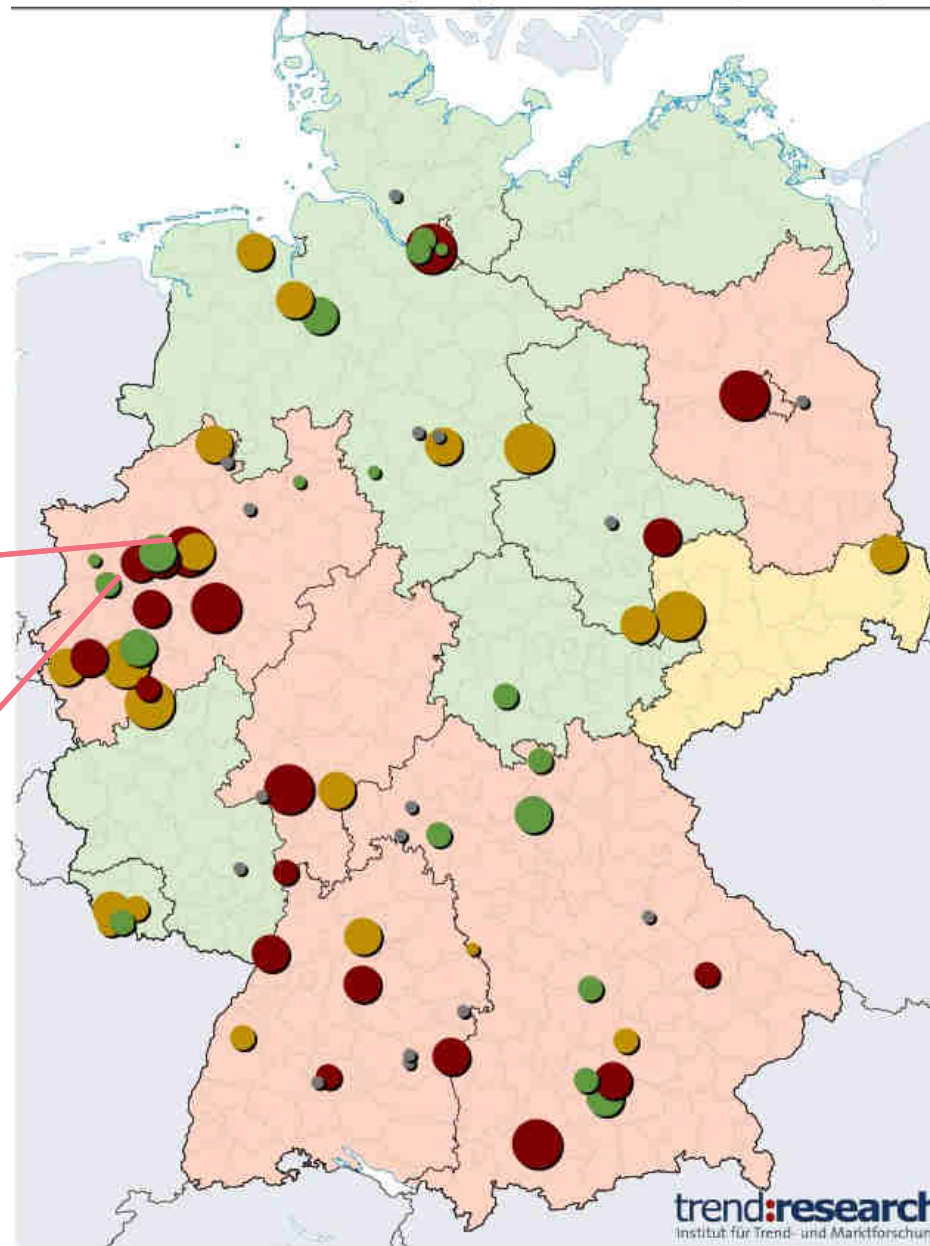


- Location: Lille, France
- Commissioning: May 2018
- Input material: biological thickened sludge
- Input mass: approx. 4 tons/day
- Output: Phosphate salts
- Output mass: approx. 9-10 kg/day as P product

Main sewage sludge disposal pathways in German regions (2014)
Mono & Co-incinerators (2016)

Innovatherm
 (95.000 t TM/a)

ZSB Bottrop
 (44.000 t TM/a)



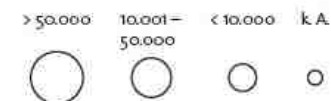
Hauptentsorgungswege
 pro Bundesland

- Landwirtschaft
- Landschaftsbau, Maßnahmen
- Thermische Entsorgung

Anlagenart

- Monoverbrennungsanlage
- Kohlekraftwerk
- Zementwerk
- Müllverbrennungsanlage

Kapazität (t TS)



Follow us!

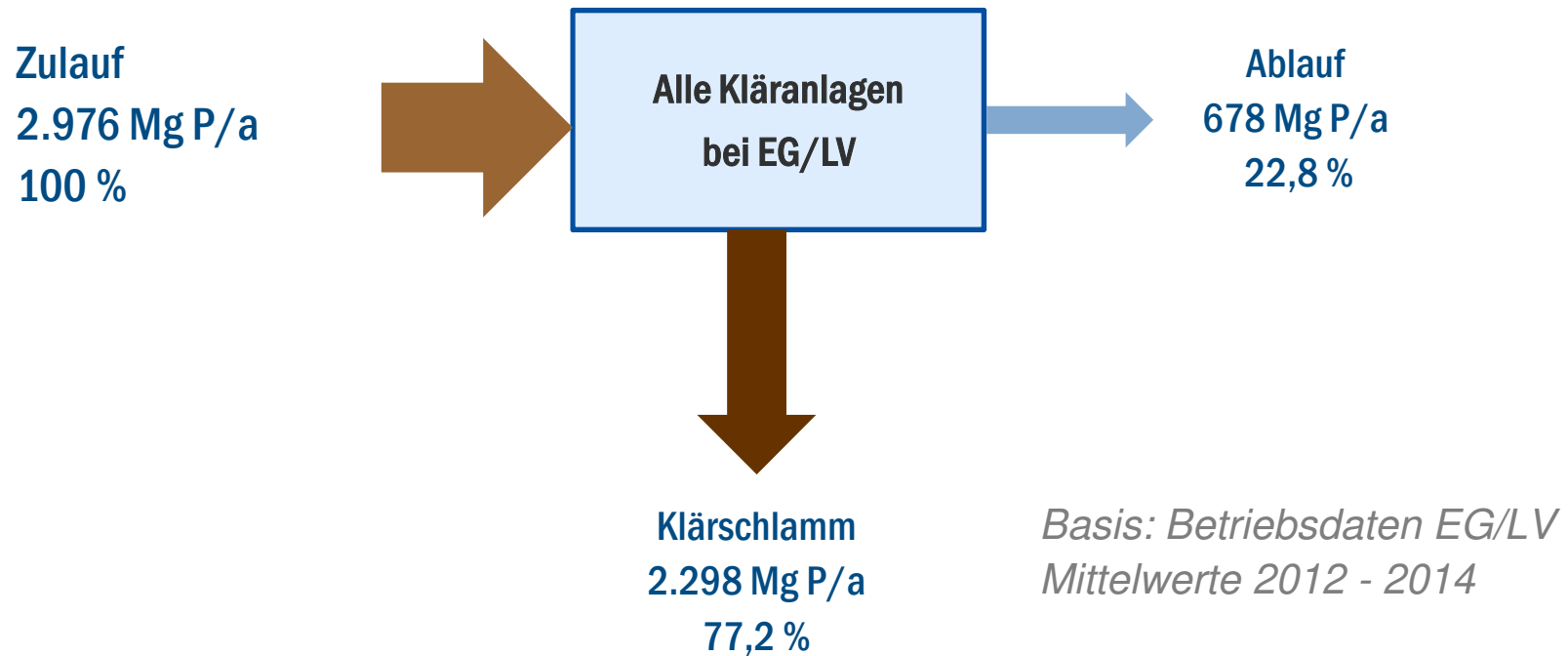
www.nweurope.eu/phos4you



University of Applied Sciences and Arts Northwestern Switzerland
 School of Life Sciences



P-Bilanz von EG/LV

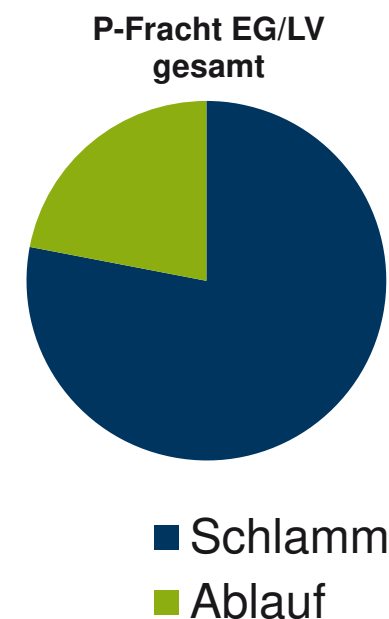


- Klärschlammanfall bei EG/LV: ca. 90.000 Mg TR/Jahr
- Mittlerer P-Gehalt im Schlamm: 2,5 % (25 g P/kg TR)
- 85 % des P-Anfalls bei EG/LV entfallen auf 14 (größere) Kläranlagen

85% der Phosphormenge fallen auf 14 Kläranlagen an (1.983.269 kg_{Pges}/a aus einer gesamt Phosphormenge von 2.298.106 kg_{Pges}/a)

Tabelle 5 Übersicht der Kläranlagen (85% anfallende Phosphormenge)

Kläranlage	Anfallende Phosphormenge [kg _{Pges} /a]	Zuständigkeit
Emschermündung	678.140	EG
Bottrop	457.717	EG
Dortmund Deusen	222.935	EG
Duisburg Alte Emscher	111.040	EG
Hamm-West	110.072	LV
Lünen-Sesekemündung	71.193	LV
Dortmund Scharnhorst	69.548	LV
Kamen-Körnebach	65.504	LV
Soest	40.008	LV
Dorsten	39.400	LV
Dinslaken	33.705	LV
Dattelner Mühlenbach	32.521	LV
Hamm Mattenbeck	26.456	LV
Gelsenkirchen Picksmühlenbach	25.030	LV
Summe	1.983.269 kg _{Pges} /a von 2.298.106 kg _{Pges} /a	



P-Potenzial der WSÖ

ZSB Bottrop

Ca. 17.000 t Asche pro Jahr

Phosphor-Gehalt: ca. 5,0 % P/kg TR (ca. 11,5 % als P_2O_5)

⇒ 850 t P/a bzw. rund 2.000 t/a Phosphat als P_2O_5

Innovatherm Lünen

Ca. 45.000 t Asche pro Jahr

Phosphor-Gehalt: ca. 3,5 % P/kg TR (ca. 8,0 % als P_2O_5)

⇒ 1.575 t P/a bzw. rund 3.600 t/a Phosphat als P_2O_5

Summe:

⇒ 2.425 t P/a bzw. rund 5.600 t/a Phosphat als P_2O_5

⇒ entspricht etwa 5 % des P-Gehalts aller DE-Klärschlämme

⇒ entspricht 12% der P-Potential aus DE-Klärschlammasche (19.000 tP/a)

 **Ca. 2% der P-Importe nach Deutschland (ca. 130.000 t P/a)**