P-REX

KOMPETENZZENTRUM WasserBerlin

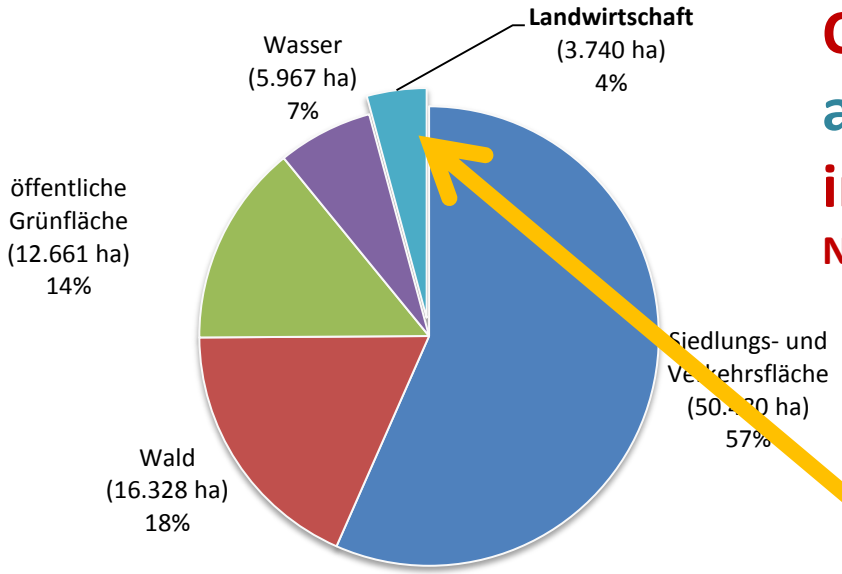
Recovery and recycling options for urban P

Dr Christian Kabbe

4th SPS, Montpellier 1-3 Sep 2014

To be identified - Structural differences!

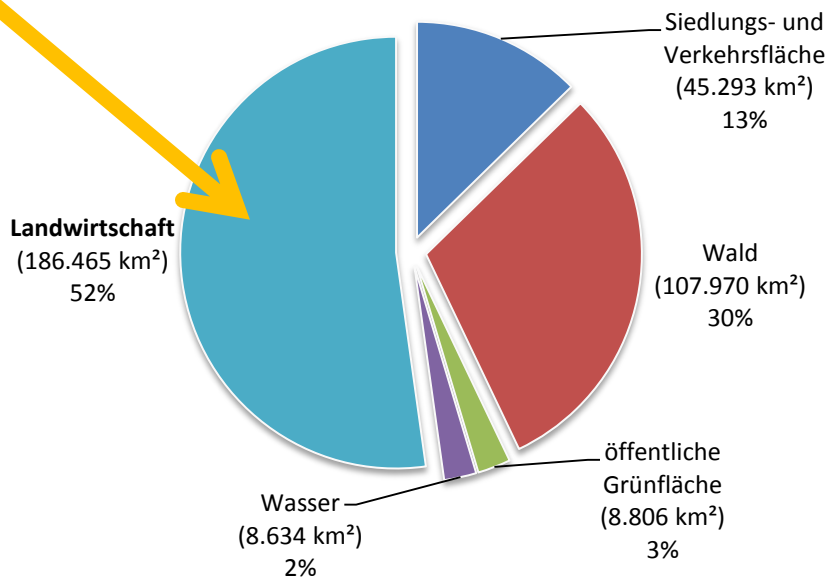
Berlin 89.176 ha



Compared to national average, agriculture does not play an important role in Berlin!

Not a relevant market for fertilizers!

Germany 357.169 km²



Berlin 2012/13:
~85 Mg P in form of mineral fertilizer sold!

56 farmers (3740 ha)

74,526 garden plots (3064 ha)
(Market potential study BWB)

Source: DESTATIS 2013

From recovery to recycling – a market?

Mineral fertilizer sales in Brandenburg
quantity in 2012: 3754 Mg P
(90% multi nutrient, 10% P fertilizer)

~ 70% of Brandenburgs P in mineral fertilizer could be covered by wastewater
***P made in Berlin*!**

Sludge mono-incineration in Berlin Ruhleben, Donat©

Identify/quantify relevant waste streams

Waste stream	P load [Mg P/a]	Recycled today? [Mg P/a]
Wastewater/sludge	2.841	40
Organic fraction in municipal waste (42%)	297	no
Household composting	79	206 (compost)
BIOGUT	24	
Commercial organic waste	62	
Green waste and lop	41	
Horse dung	13	13
Wood ash	51	no
Total P	**3,408**	**259**

No slaughterhouses in Berlin -> no meat and bone meal
Municipal waste incineration ash: 0.3% P

Kabbe, Bäger and Mancke 2014

P potential in Berlin‘s wastewater stream

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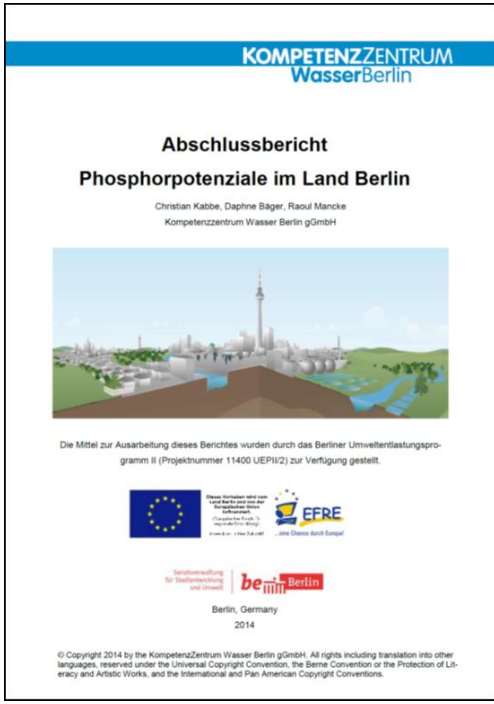
Total P load (influent) treated by BWB: 2.841 Mg P

from Berlin	86 %	14 %	from Brandenburg
2.452 Mg P			389 Mg P

Struvite recovery limited to dissolved ortho-P and therefore not competing with P recovery from i.e. ash but complementary

Loss to surface water	Struvite	Sewage sludge
90 Mg P	40 Mg P	2.711 Mg P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Abschlussbericht

Phosphorpotenziale im Land Berlin

Christian Kabbe, Daphne Bäger, Raoul Mancke
Kompetenzzentrum Wasser Berlin gGmbH

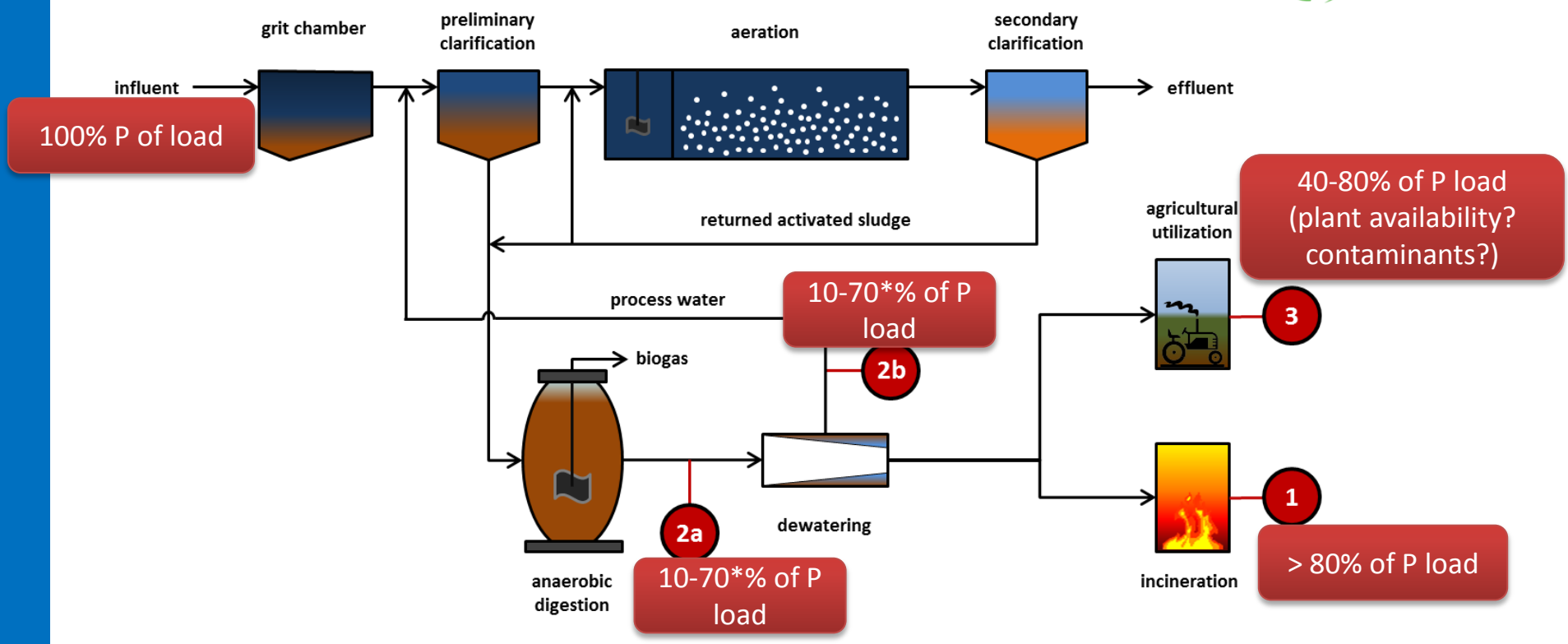
Die Mittel zur Ausarbeitung dieses Berichtes wurden durch das Berliner Umweltentlastungsprogramm II (Projektnummer 11400 UEPII/2) zur Verfügung gestellt.

EFRE

Berlin, Germany
2014

Kabbe, Bäger and Mancke 2014

Hot spots for P recovery in WWTP



(amended from Montag 2010)

1 ash after incineration

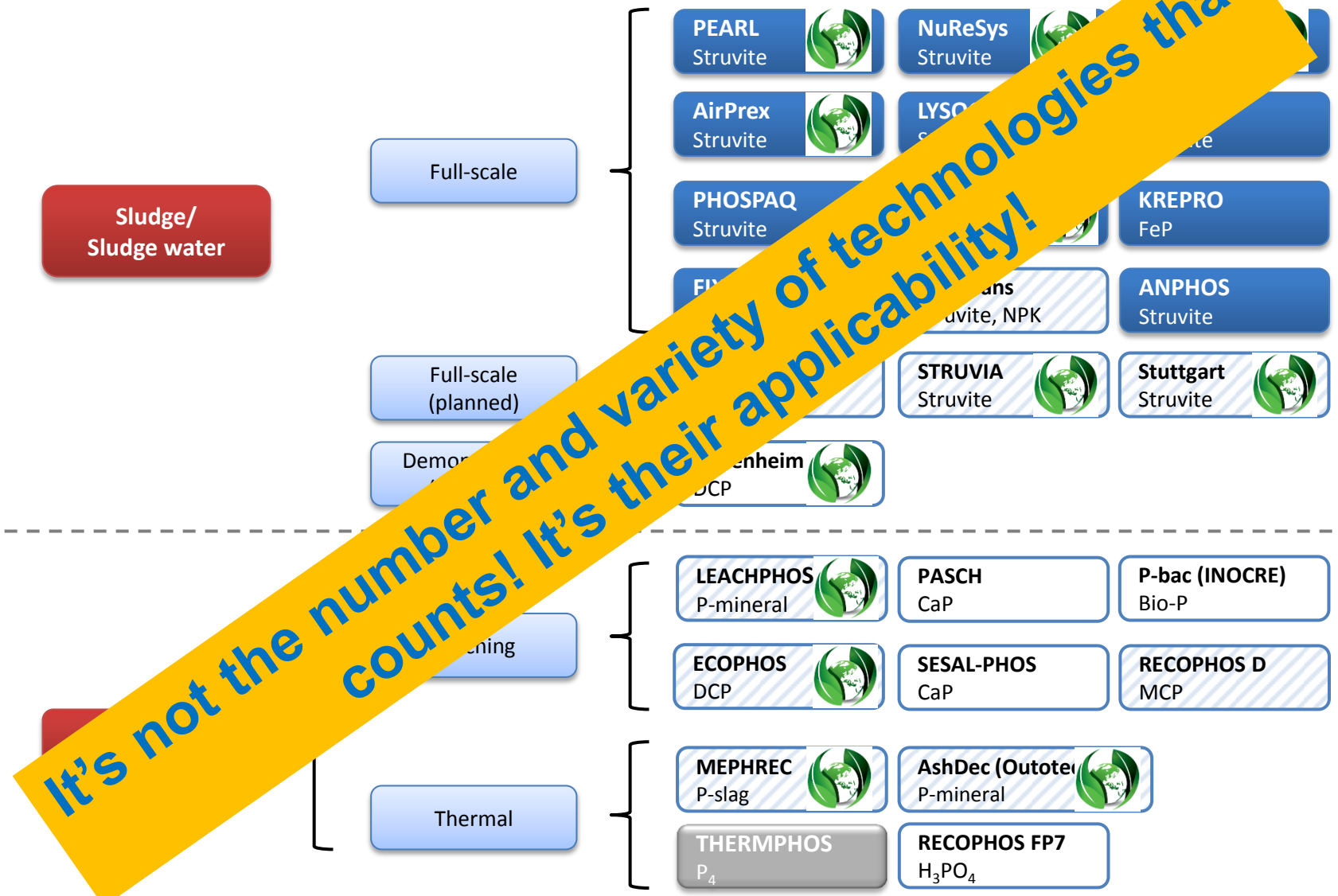
2a undrained sludge after anaerobic digestion

2b sludge liquor after dewatering

3 direct agricultural utilisation of dewatered sludge

*High recovery rate only after enforced P extraction from solid phase

Overview of P-recovery from wastewater technologies in Europe



It's not the number and variety of technologies that counts! It's their applicability!

KOMPETENZZENTRUM WasserBerlin

Full-scale | Demo | Lab/pilot

www.p-rex.eu

P recovery from sludge water

The MAGIC of STRUVITE ($MgNH_4PO_4 \times 6H_2O$)

© Kabbe, AirPrex unit in Wassmannsdorf

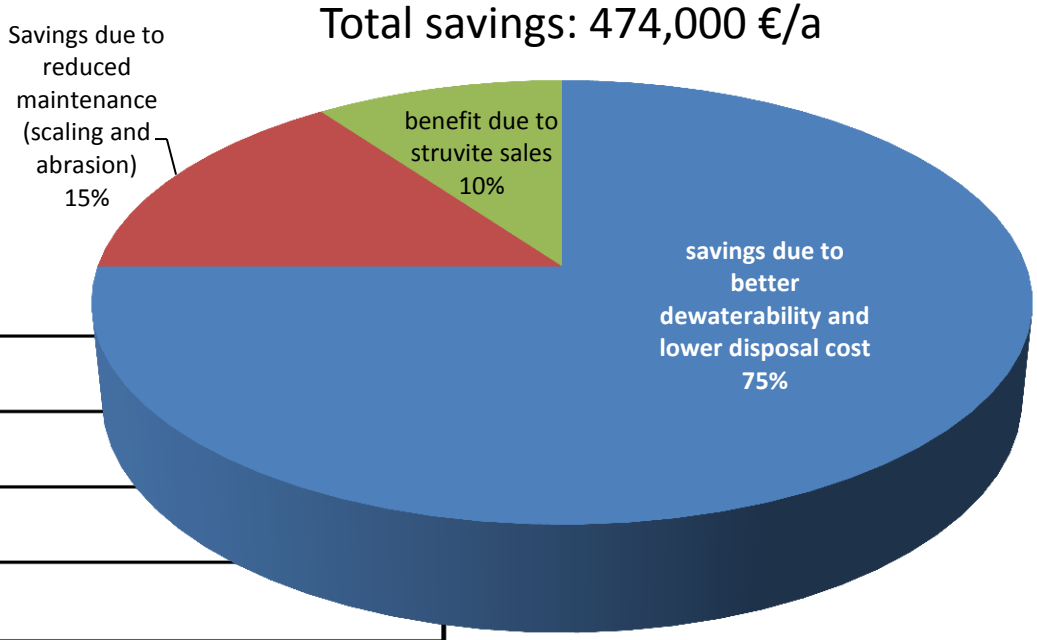
© NuReSys

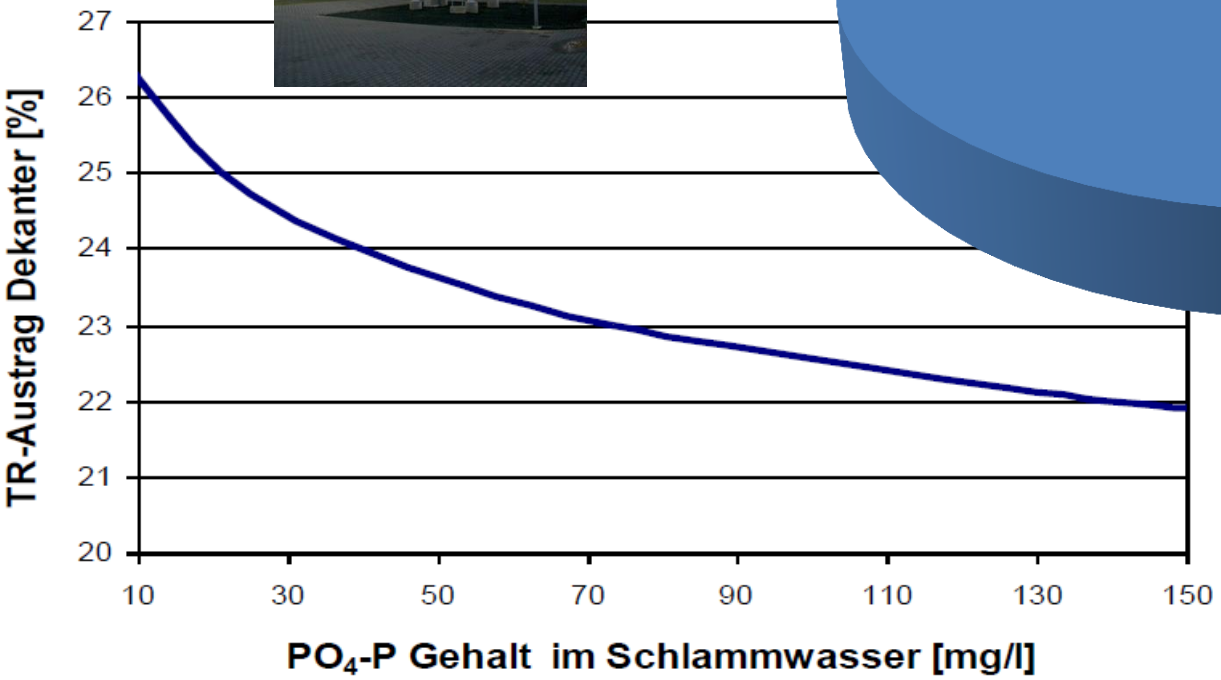
www.ostara.com/sloughUK

P recovery – feasibility example

The practical example of WWTP Neuwerk (Niersverband)

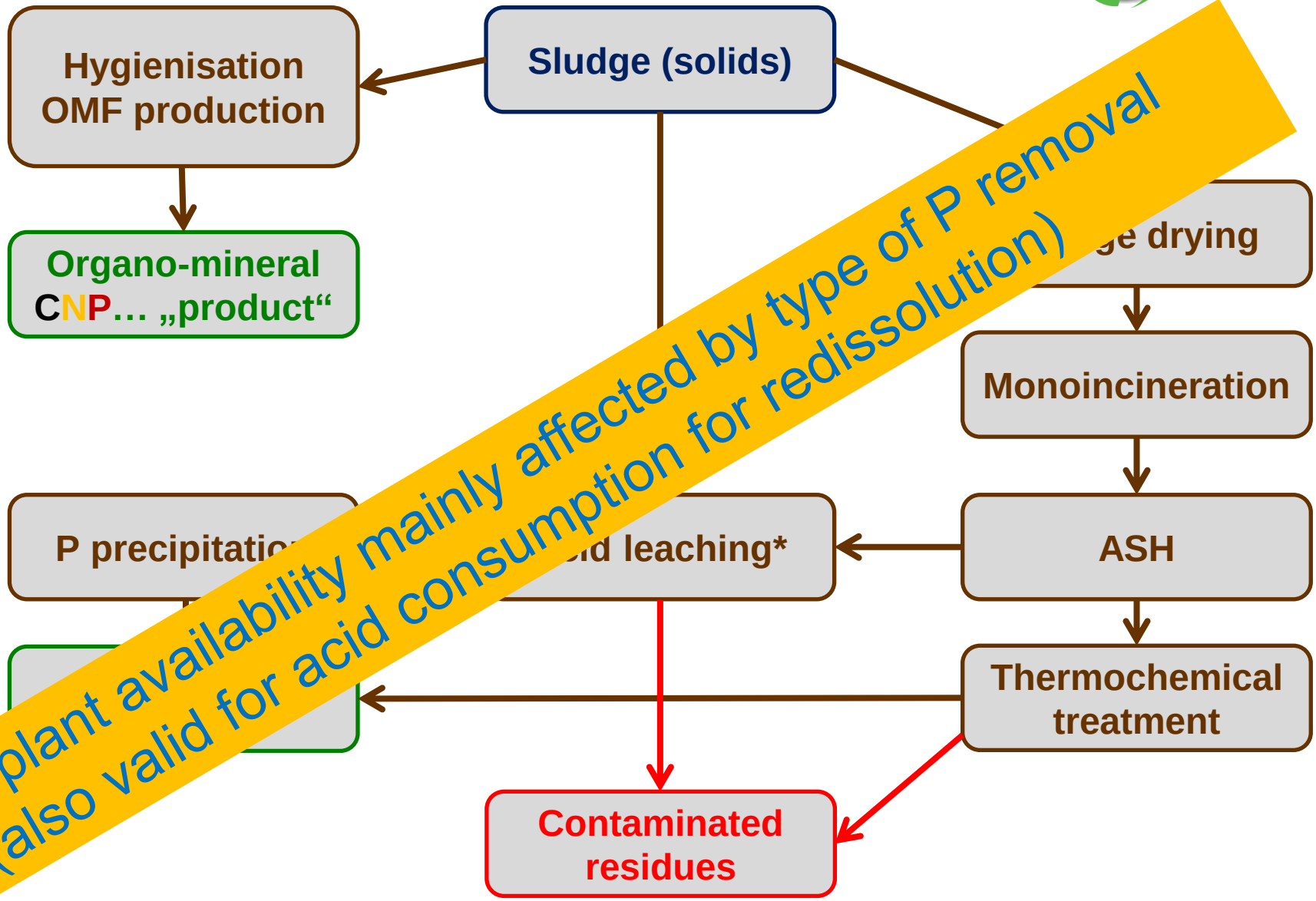
Total savings: 474,000 €/a





Sources: Niersverband and P.C.S.

P recovery: solid phase – catching the big fish



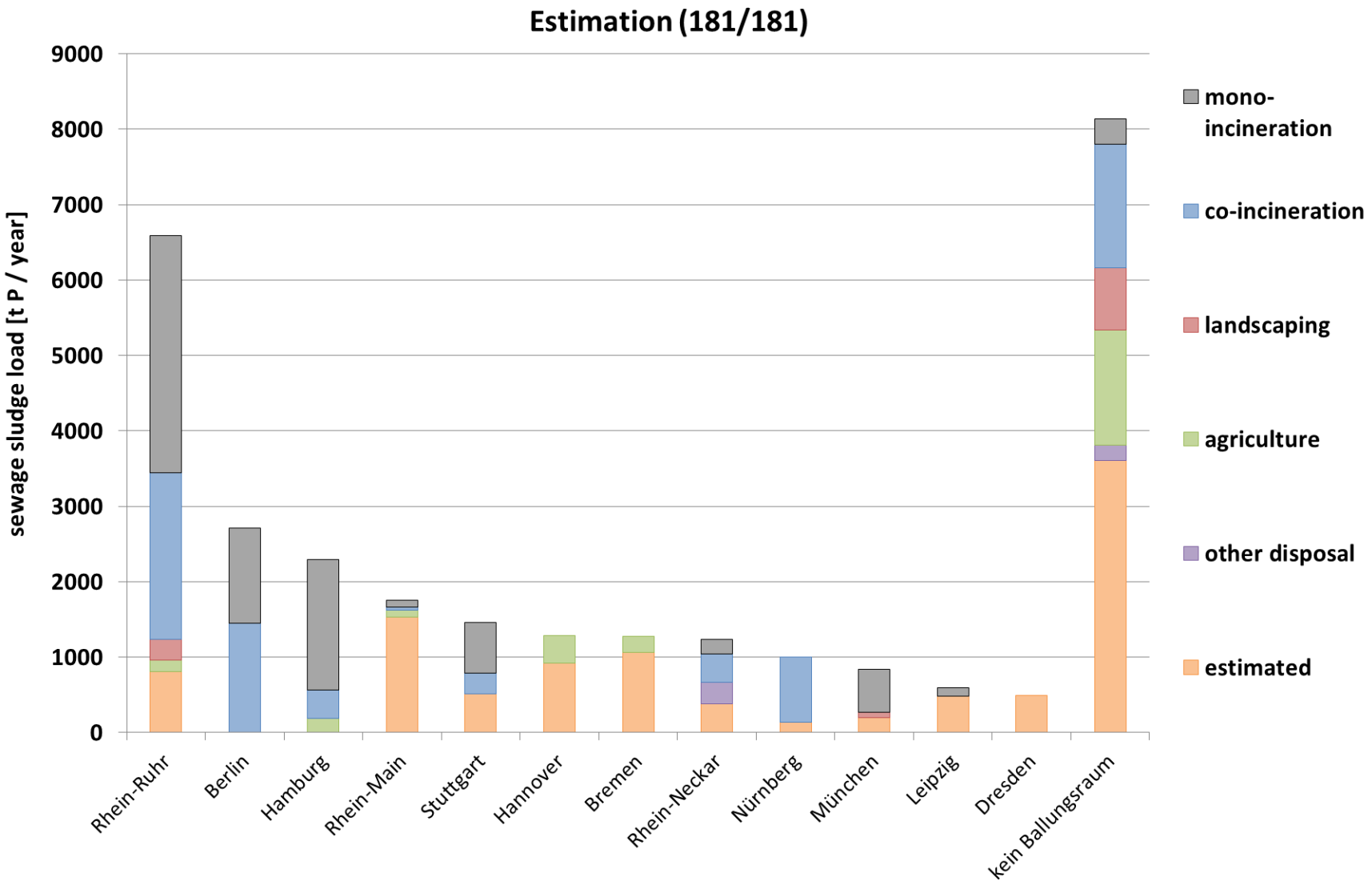
Regional hot-spots – the class 5 survey – biggest fish

Mapping in clusters:

- ca. 72,6 % of phosphorus in sewage sludge of GK 5 accrue in these clusters (min 21.500 t P/a to max 29.700 t P/a)
  - 103 wastewater treatment plants (56,9 % of class 5)
  - ca. 47,1 · 10^6 inhabitant equivalents (86,4 %)
  - ca. 3 · 10^9 m³ wastewater treated per year (74 %)

181 GK5 WWTP in Germany

Disposal routes and P potential per agglomeration



Kraus, F. 2014

How to develop a EUROPEAN market for recovered P?

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- Enabling **Technologies**: proof of concept and feasibility? Suitable infrastructure? Regional conditions? But, recovery alone is not recycling!
- P_{rec} **products**: real market requirements beyond legal baseline? [illegible] side)
  - No market without endusers and products [illegible]!

NO RECYCLING WITHOUT MARKET!!!

Baseline

Nutrients
Contaminants
Plant availab[illegible]
Eco-toxi[illegible]
Hygiene
Listed fertilizer
End of waste

(BWB)

Success factors

Price
Purity (esp. HM and organic compounds <1%)
Fe and Cl content are limits
Odour
Available Quantities,
Handling, (particle size, storage, use of existing equipment)
Distribution infrastructure
Operational benefits
Consumer concerns?

REACH – not to be forgotten!

- Registration at ECHA (European Chemicals Agency) for substances and compounds (chemicals) produced/traded in EU in quantities:
  - ≥ 1000 t/a since 01.12.2010
  - ≥ 100 t/a since 01.06.2013
  - ≥ 1 t/a from 01.06.2018

  What about national interpretation of recovered/recycled „products“?

- Struvite successfully registered by BWB (lead registrant) last summer
  - One market obstacle was taken by registration
  - Co-registration much easier and far less expensive for struvite producers/traders now
  - Dossiers for co-registration can be accessed through Berliner Wasserbetriebe (LOA Letter of Access)

Berliner Wasserbetriebe

National interpretations of EU legislation!

Take home …

- Paradigm shift: **waste** streams are "**renewable resources**" …
- **Enabling technologies** for P recovery **available** (and feasible)
- **Only** techs providing **marketable** intermediates or **products likely for recycling**
- Make **smart use of existing infrastructure** instead of reinventing the wheel
- Current **motivation** for implementation: **operational benefits** and security of supply (company level)
- **Legal framework needs more reliability and harmonization (Targets??? example CO_2)**
- **Struvite** is a **pioneer** substance paving the road **for other recyclates**!
- **Nutrient recycling value chains**: It's not the job of WWTP operators to become fertilizer manufacturers and/or retailers! -> **multi-stakeholder business models**

Outlook

- **Every kg P counts! Bottleneck of life (limits the biomass potential)! (food or energy?)**
- **Bridging the gap between supply (recovery) and demand (recycling)**

> **“Knowing is not enough; we must apply. Willing is not enough; we must do.”**
>
> *>> Johann Wolfgang v. Goethe <<*

- **Technology alone won’t save the world!!!**
- **It’s up to every one of us knowing and willing to apply and do by using opportunities already at hand!!!**

P-REX in two minutes – watch and circulate!

- Finalized in October 2013 in EN online at VIMEO since November 2013
- Additional languages with subtitles online since February 2014

CZ: http://vimeo.com/84936506

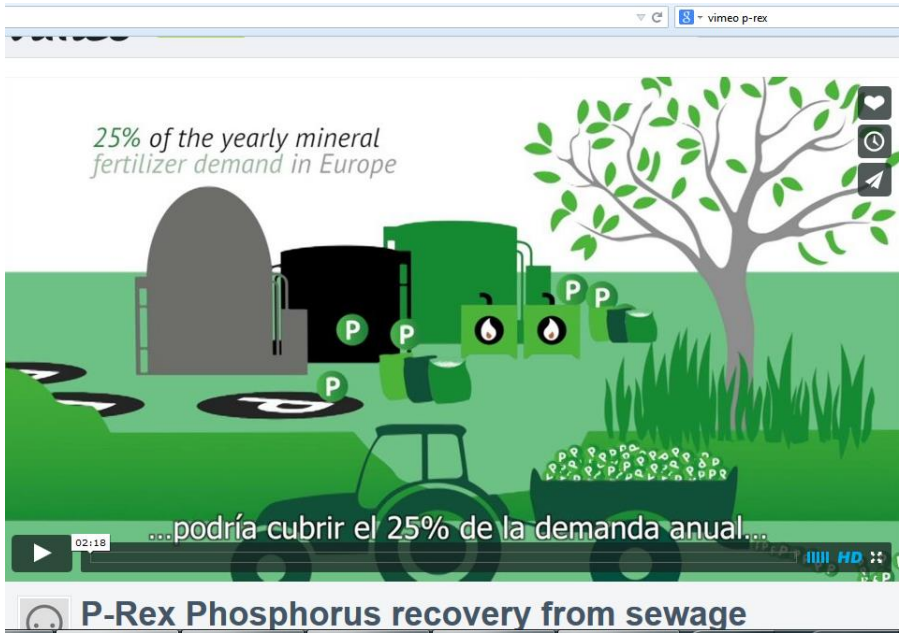
DE: http://vimeo.com/84936509

EN: http://vimeo.com/78539404

ES: http://vimeo.com/84936510

FR: http://vimeo.com/84936508

SE: http://vimeo.com/84936512



Overview: http://vimeo.com/user22393541/videos

P-REX

Thank you!

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PHOSPHORUS RECYCLING
FROM PROTOTYPE TO MARKET

SEVENTH FRAMEWORK PROGRAMME

KOMPETENZZENTRUM WasserBerlin