



P-REX

General P recovery and recycling implementation aspects

Policy briefing, pre-normative matrix and eMarket

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PHOSPHORUS RECYCLING
FROM PROTOTYPE TO MARKET



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Context:

What would change if... phosphorus from wastewater stream was recovered?

Today

- 5-7 large industrial phosphorus fertiliser producers control the market
- > 50'000 tP/a
- identical starting materials (P-rock)
- dependent on import (92%)
- starting and end – materials are products

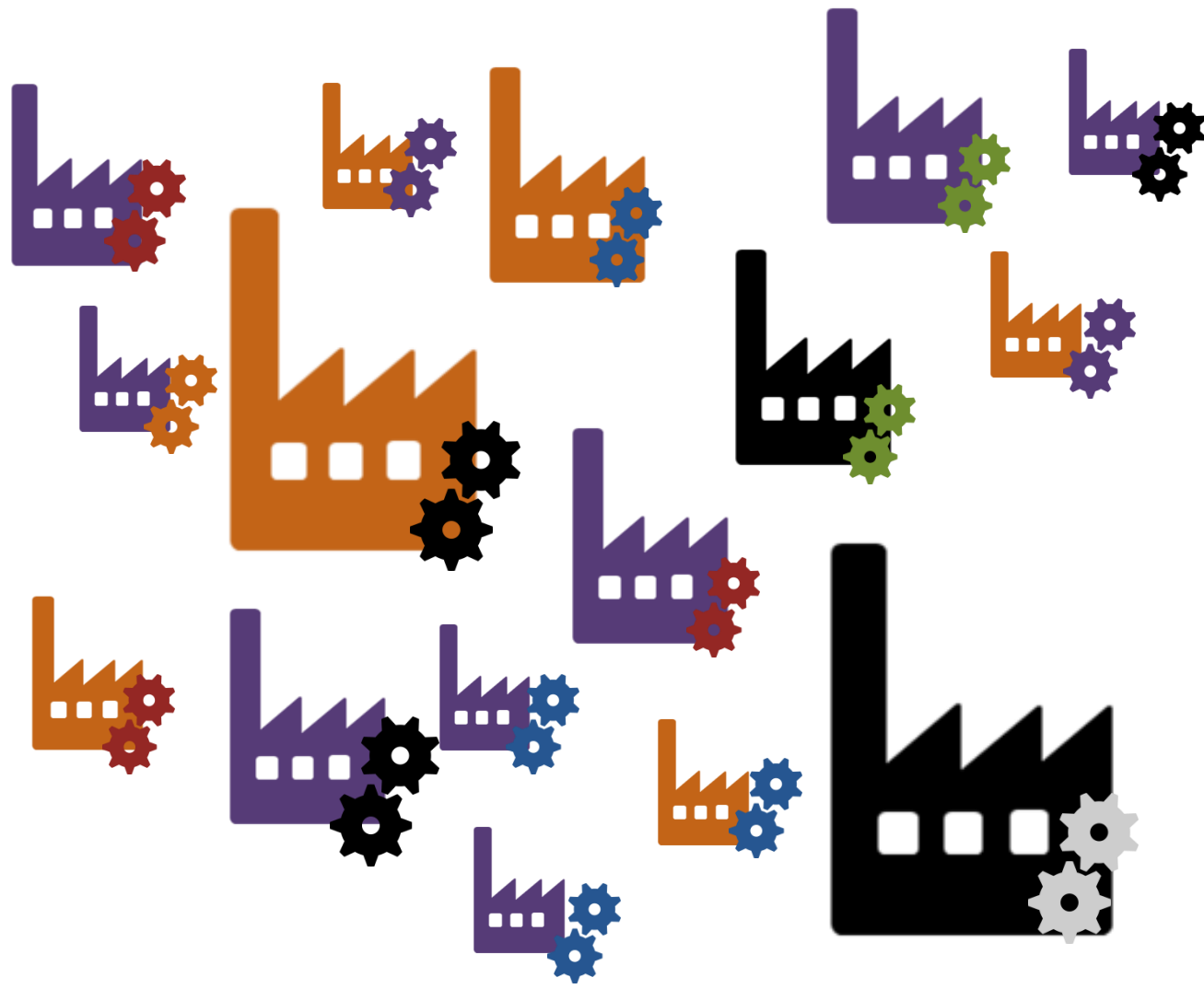




Context:

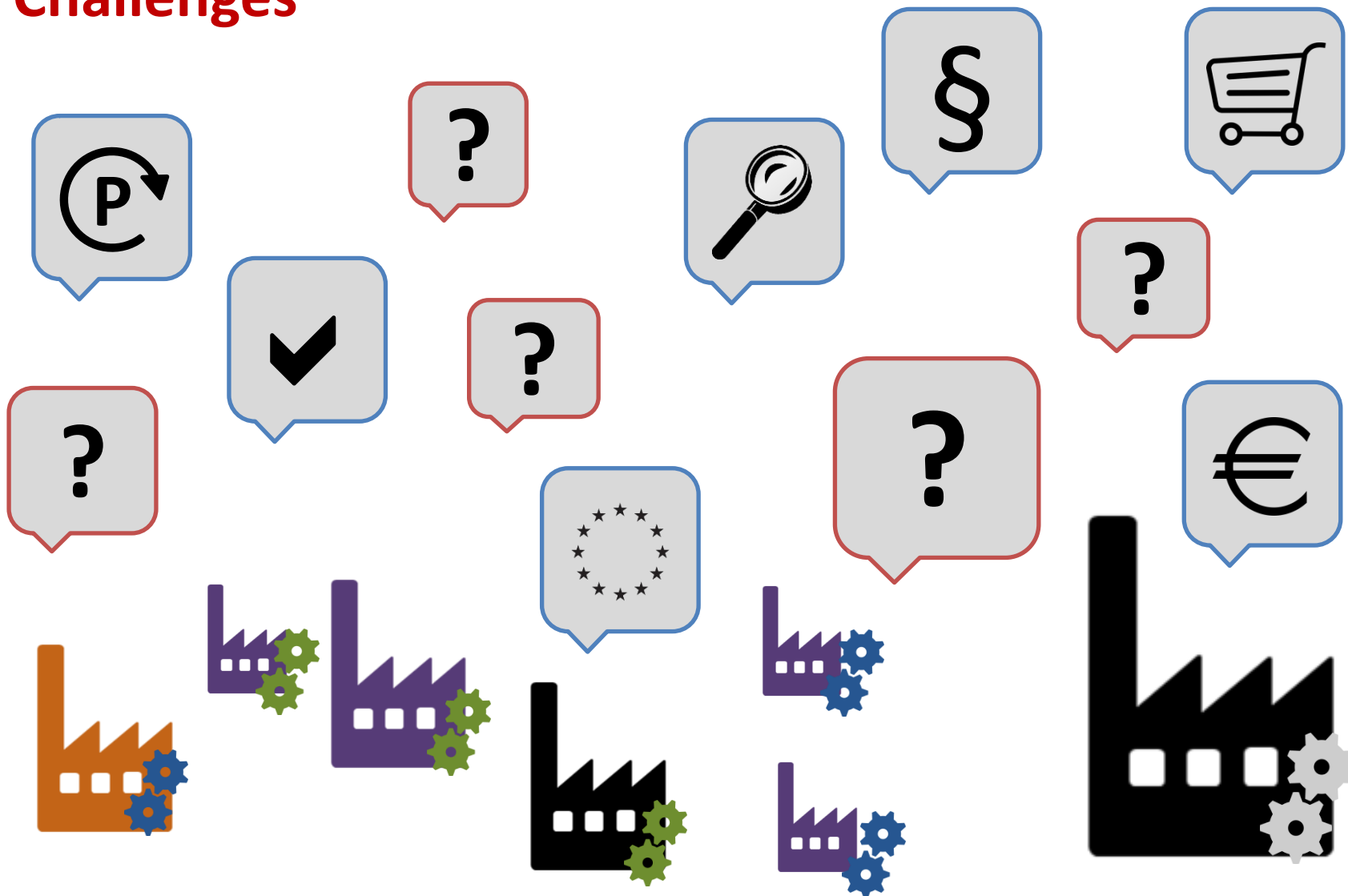
What would change if... phosphorus from wastewater stream was recovered?

- Tomorrow**
- hundreds of small production plants
 - 50 - 5'000 tP/a
 - WWTP, technology start-ups, fertiliser industry
 - Different starting materials (sludge, ash, other)
 - several different processes
 - starting (and end) materials with waste status



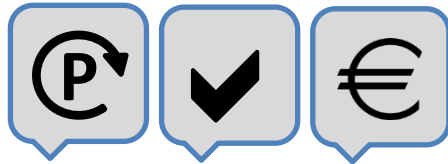


Challenges



Content:

What can we do to facilitate the change?



1. Pre-normative matrix

- How to identify suitable product quality categories for a recovered P market?



2. eMarket

- How to match the supply and demand of recovered P?

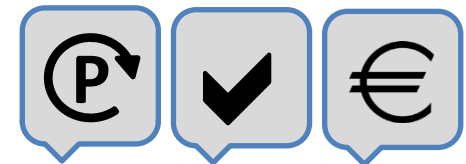


3. Policy brief

- How to lower the current market and legal barriers for P recovery?

Pre-normative matrix

- **Quality** and **price** of recovered materials were compared with the requirements of the
 - fertilizer, feed and technical markets
- **Aims**
 - first step towards identifying suitable categories for recovered phosphorus
 - communicating quality-price relationships to the buyers and sellers of recovered materials
 - **facilitate production and use of secondary phosphorus**



Pre-normative matrix: Evaluation

Recovered / recycled materials

Sewage sludge

Sludge ash

Struvite

Treated
sewage sludge
ash

Reference market segments

Feed

(2003/100/EC)
(W. Schipper 2013)

**Other non-
food uses**

(W. Schipper 2013)

Fertiliser

(German f
regul

**No EU
criteria!**

Quality: heavy metal and organic contaminant limit values	++	All requirements met
	-	All but one requirement met
	--	Several requirements not met
Quality: nutrient concentration	Measured concentrations for several macro and micro nutrients in comparison to TSP	
Quality: Plant availability in comparison to TSP	+ (good)	≥ 80 %
	0 (limited)	50-80 %
	- (poor)	0-50%
	P-solubility in NAC and H2O or RFE in comparison to TSP	
(disposal) Price	€/t P	



Market segments

Fert.	Feed	Non-food	Sewage sludge		Sludge ash		Struvite		Treated sewage sludge ash		
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Limits (mg/kg)		min	max	min	max	min	max	A	B	C
Feed	As < 10; F < 2000 and other limits	--		--		--		--	--	--
Non-food	Fe, Mg, Ca, Al: 10 to 300	--		--		--		--	--	--
Fertiliser	As < 40; Pb < 150; Cd < 50 (mg/kg P ₂ O ₅);	- ⁷		- ⁷	++ ⁷	++	++	++	++ ⁷	++ ⁷
Inorganic contaminants	Cr(VI) < 2; Ni < 80; Hg < 1; TI < 1									
Organic contaminants	Perfluorinated tensides < 1; I-TE dioxins and dl-PCB < 20 ng-WHO TEQ	++		- ⁸	- ⁸	++	++	9	9	9

Nutrients (%)		TSP								
P (phosphorus)	23	3	4	10	10	14	12	6	4	
K (potassium)	1	0	0	1	0	2	0	1	1	
N (nitrogen)	0	6	0	0	5	5	0	0	0	
Mg (magnesium)	1	0	1	2	8	11	1	1	2	
Ca (calcium)	19	3	5	24	0	1	22	10	24	
S (sulphur)	1	2	0	2	0	1	7	1	0	

P Plant availability										
P plant availability in pot tests (1 yr)	+	0	+	-	0	+	+	+	-	
Solubility in Water	+	-	-	-	-	-	-	-	-	
Solubility in neutral Ammoniumcitrate	+	+	+	-	+	+	+	+	-	

Price range (Euro/to P; delivered)									
Market price range	Rock (14% P) 400 -1500 (500) TSP (20% P) 800 - 2100	DCP (25% P) 2000¹¹	H ₃ PO ₄ (8% P) 2000 - 3000¹²	-2000 to -9000¹³	-1000¹⁴	300 - 1000 (Niches up to 6000) ¹⁵	"Rock" (14% P) 850 - 1100 DSP (16% P) 1200 - 1600¹⁶	not known 700 - 1700¹⁷	

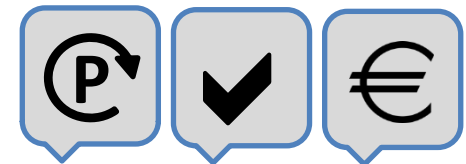
Pre-normative matrix - Conclusions

- **Quality**

- recycled materials comply with the current legal requirements for fertilizers in Germany
- all but one can be evaluated as plant available
- the phosphorus concentrations are in the range of phosphorus rock or sewage sludge ash, somewhat lower than conventional fertilizers

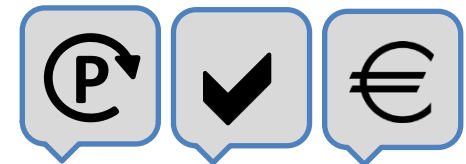
- **Price**

- The offered and projected price ranges for recycled mineral phosphorus-containing materials are largely in line with those in the fertilizer market and dependent on grade and plant availability
- Higher prices could be obtained for phosphorus for feed and other non-food uses, but most recycled materials do not fulfill the more stringent technical and legal requirements for these markets.



Pre-Normative Matrix - Conclusions

- The matrix can be further detailed and updated
 - to serve as an orientation on price-quality relationships for recyclers and customers.
 - to direct process development and sourcing of recovered phosphorus
- For legislation on quality categories much more detailed discussions of are necessary. These are under way in the frame of the fertilizer regulation recast.



Content:

What can we do to facilitate the change?



1. Pre-normative matrix

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2. eMarket

- How to match the supply and demand of recovered P?



3. Policy brief

- How to lower the current market and legal barriers for P recovery?

eMarket

- “Matching platform” between supply and demand of recycled P
- Aim: to facilitate the market development for recovered nutrients
- non-commercial platform
- Use and participation are free of charge with information/content given on voluntarily base
- incorporated to the website of the European Sustainable Phosphorus Platform (ESPP)

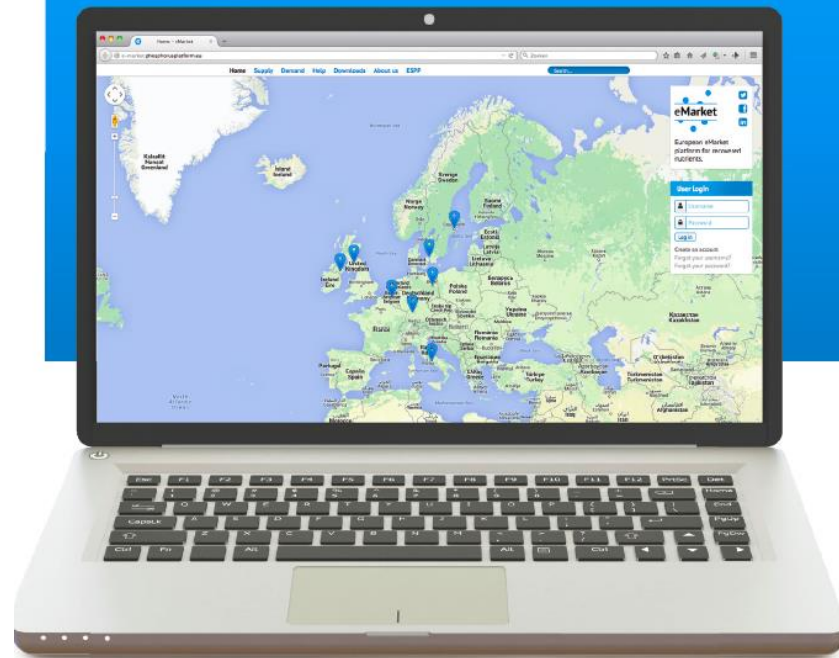




eMarket

- Match making between Supply und Demand → Bridging the gap!

eMarket Marketplace for recovered nutrients
Think forward, act circular



e-market.phosphorusplatform.eu

<https://vimeo.com/121140168>



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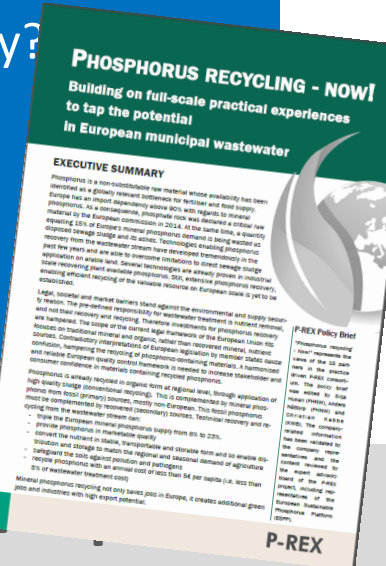
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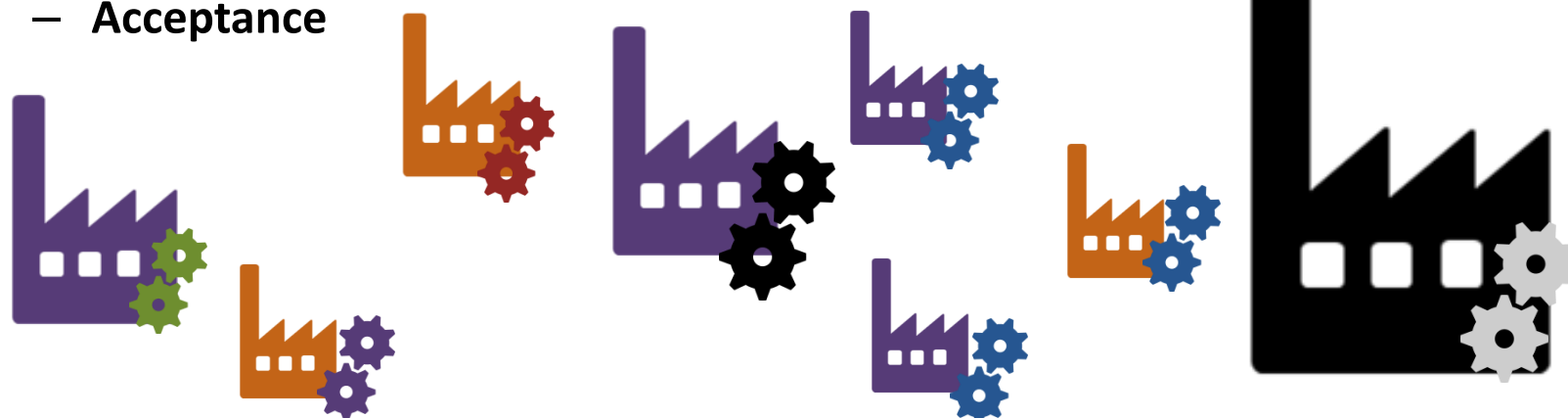
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Policy brief: Starting point

- Several technologies for P-recovery are already ready for implementation
- **But challenges remain:**
 - **Market access**, if fertilisers not key business
 - **Legal obligations** extensive (Waste Framework directive, REACH, Fertilisers Regulation), but interpretation varies!
 - Narrow definitions for fertilisers
 - **Economies of scale**
 - **Acceptance**



Why?

Long-term advantages of recycling efforts:

- supply security
- internalized environmental costs
 - not accounted for in market-based decision-making

Needed:

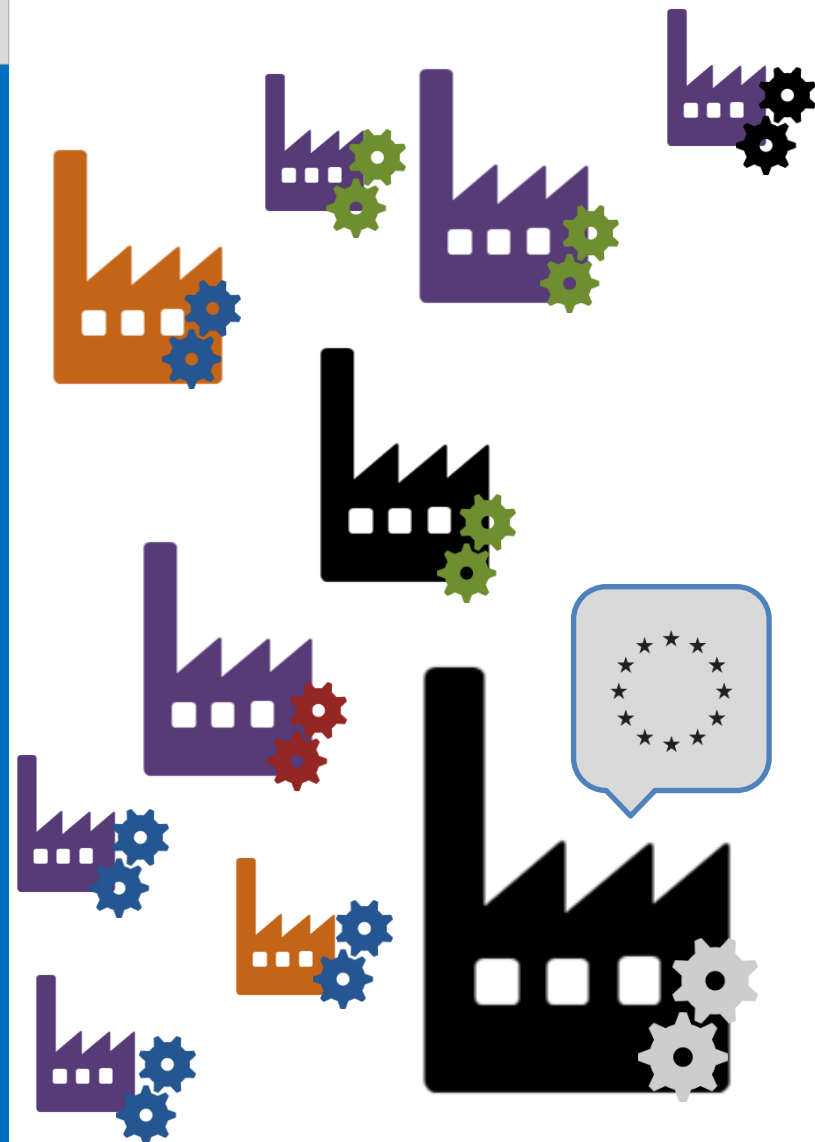
- Market drivers, long-term stability of the legal environment
- Systemic change from exclusive use of fossil P to a mix of fossil & recovered P

→ **New market players and investments**

Policy Message 1

Realistic and reliable European phosphorus recovery target, especially from wastewater.

It should be combined with a **European overall road map** and defining Best Available Technologies for phosphorus recovery and recycling.

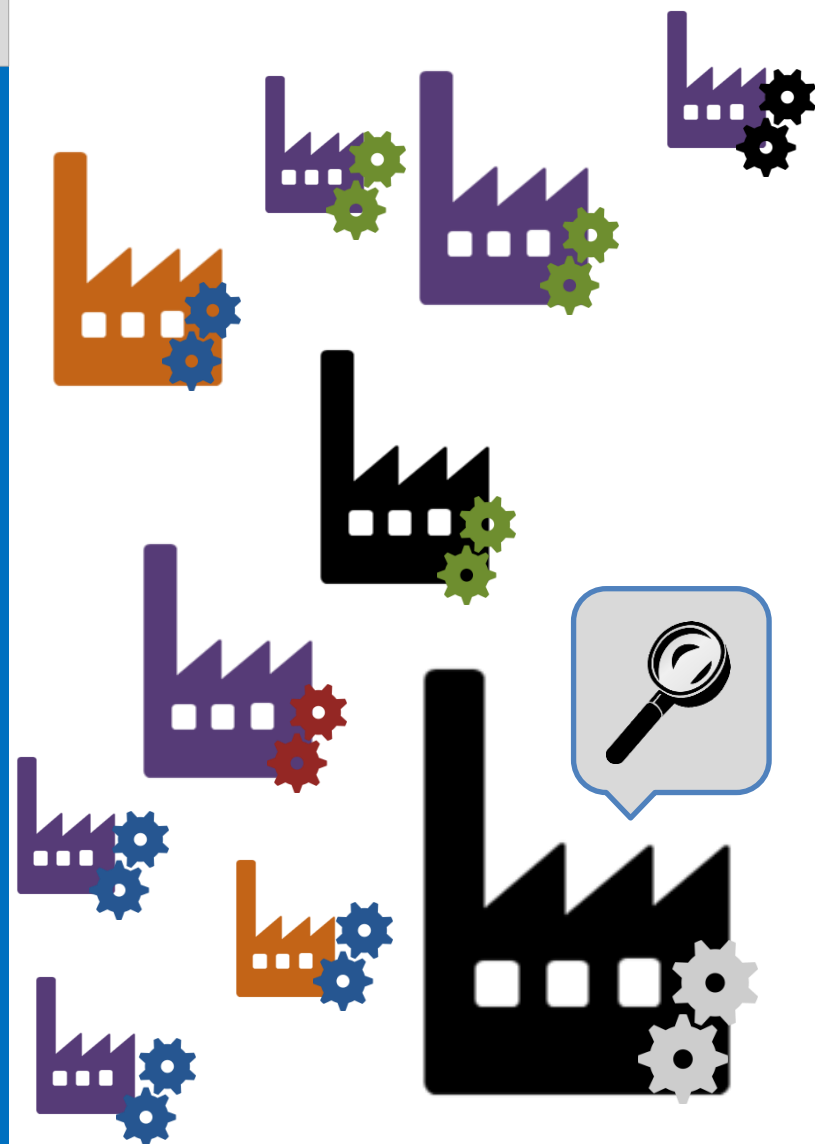


Why?

- Infrastructure, logistic, demand differences
- National coordination for efficiency
 - Synergies with existing EPBR or mono-incineration
 - Sludge management (raw material supply) optimisation
- Treatment train steps beneficial for recovery have additional cost but can be overcome by value chains

Policy Message 2

Obligation for national or regional action plans for phosphorus recovery, in line with the European goals, implementing technical recovery of phosphorus and/or agricultural valorisation of high quality sludge.



How to grant market access over Europe and increase acceptance?

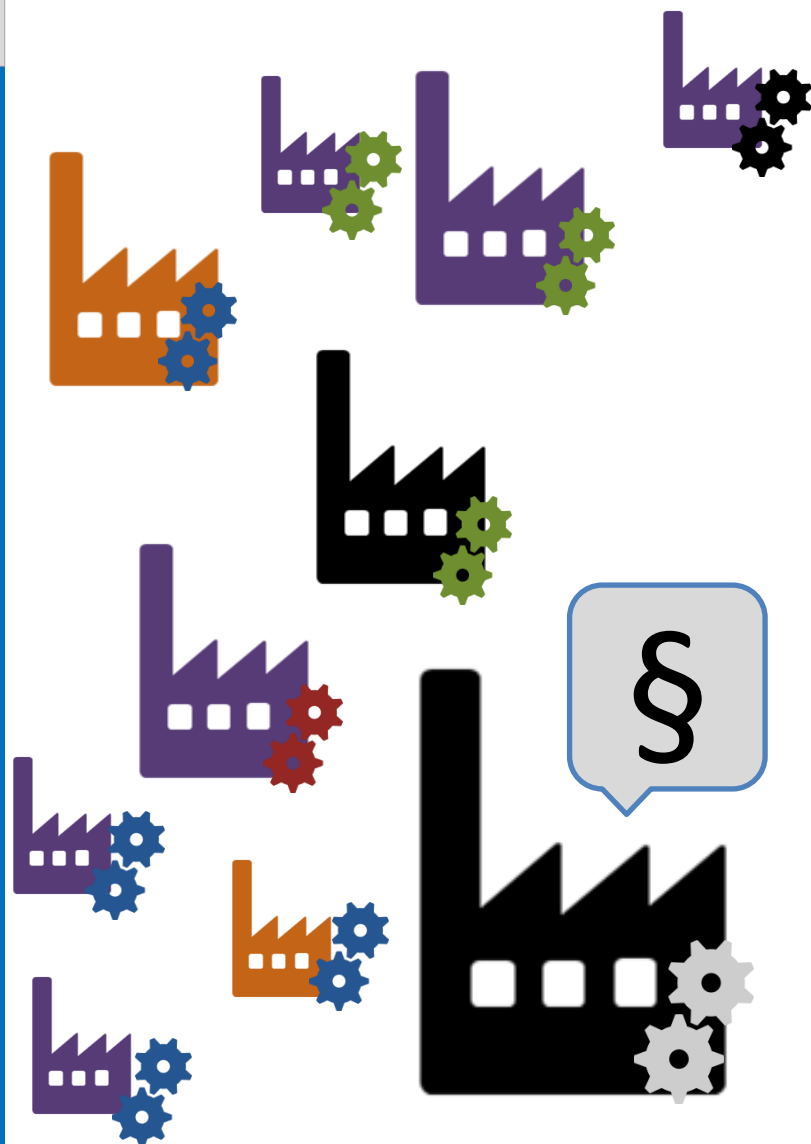
Why?

- Contradictory interpretation of legislation in member states
- Quality standards are lacking
- Fertiliser Regulation focuses on conventional sources and limits the number of start materials

Policy Message 3

Clear guidelines stopping contradictory national interpretation of the current European legislation around recycling of phosphorus from waste, especially into fertilisers.

Better integration of secondary raw materials and introduction of quality standards including end-of-waste criteria to the European Fertiliser Regulation.



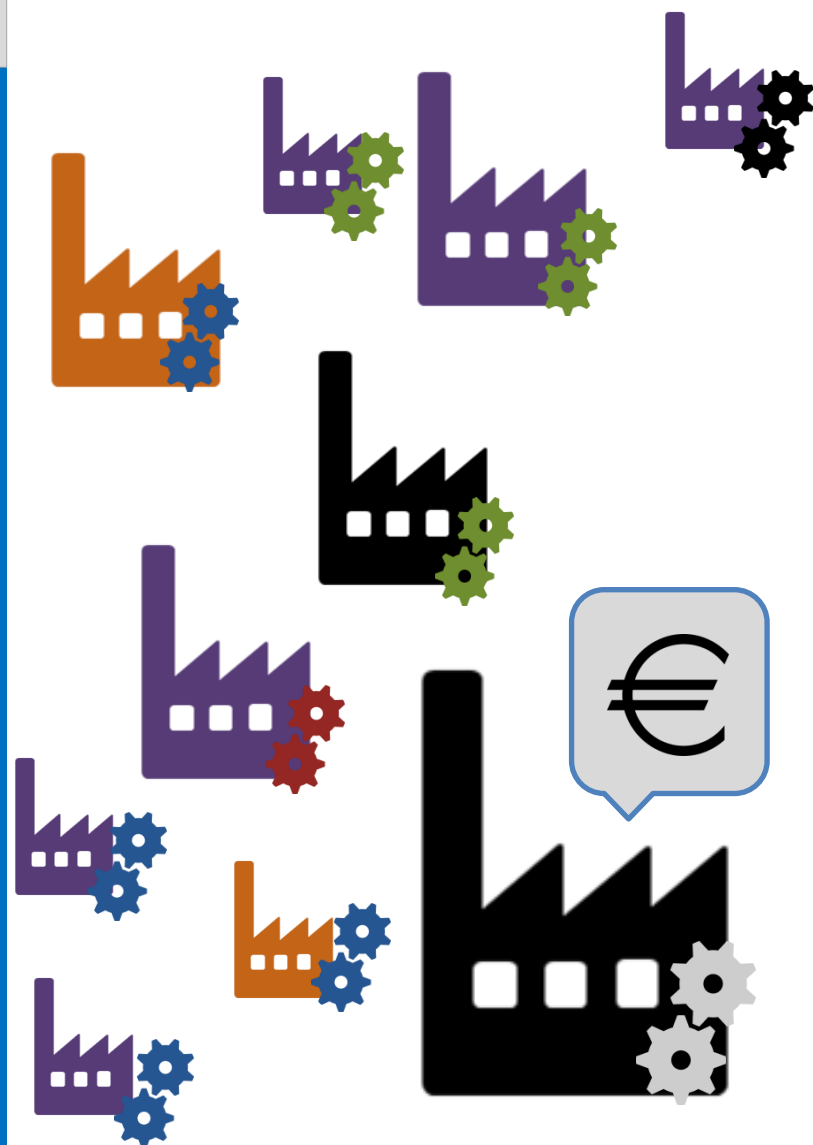
Why?

- Phosphorus recovery benefits society as a whole and comes with a cost
- First Movers Risk
 - large investment
 - a competitor implements a second generation technology and profits from changes made

Policy Message 4

National mechanisms for fair distribution of the cost of phosphorus recovery (e.g. fertilizer mixing quota, recovery obligations).

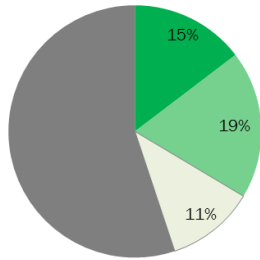
Financing of demonstration projects, since references are obligatory for market penetration of innovative technologies and products.



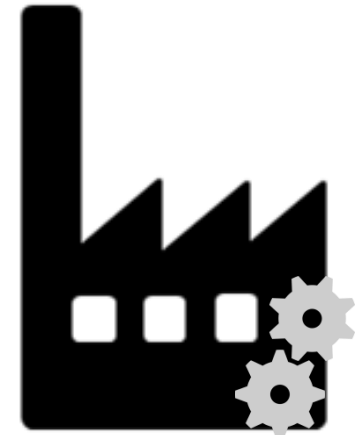
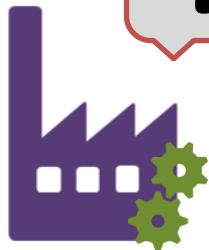
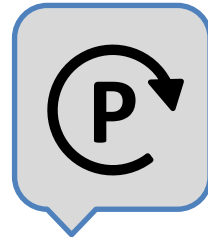


In summary:

Recovery potential



- Municipal sewage sludge
- Slaughterhouse waste
- Food-waste (household and retail)
- Demand uncovered



Be a part of the solution!

«Think forward, act circular»



P-REX

Thank you for your attention!

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Download at www.p-rex.eu :

P-REX Deliverable D11.2 - Pre-Normative-Matrix, Fertilisation Schemes and
Legal Framework for Phosphorus Recovery and Recycling

Policy brief and regional studies (D, CH, ES, CZ)

<http://e-market.phosphorusplatform.eu/>



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