Project BEST – Better Efficiency for Industrial Sewage Treatment
Międzynarodowe seminarium poświęcone odzyskowi fosforu
12.06.2018 Gdańsk

CIRCULAR ECONOMY ASSUMPTIONS IN THE PHOSPHORUS MANAGEMENT IN THE BALTIC REGION

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Polish Academy of Sciences

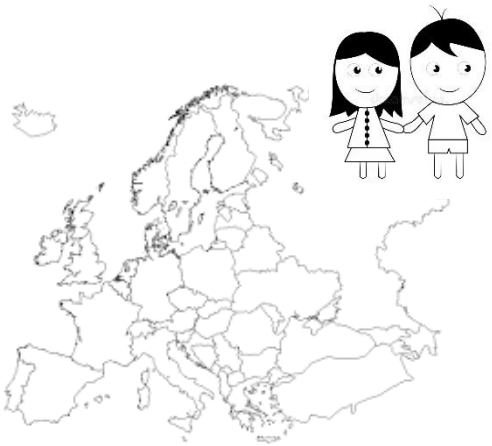
Interreg Baltic Sea Region
EUROPEAN REGIONAL DEVELOPMENT FUND
EUROPEAN UNION

BEST
Better Efficiency for Industrial Sewage Treatment

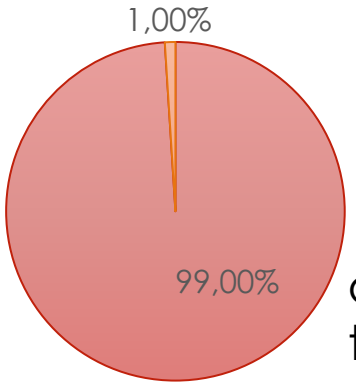
EU STRATEGY FOR THE BALTIC SEA REGION
FLAGSHIP

LEANER ECONOMY MODEL

People dump a 2.12 billion tonnes of waste per year



16 tonnes of material per person per year are used and 6 tonnes of it becomes waste (the EU)



of the stuff we buy is trashed within 6 months

Linear economy approach results in massive waste!

Source: makeresourcescount.eu, www.theworldcounts.com/counters/shocking_environmental_facts_and_statistics/world_waste_facts

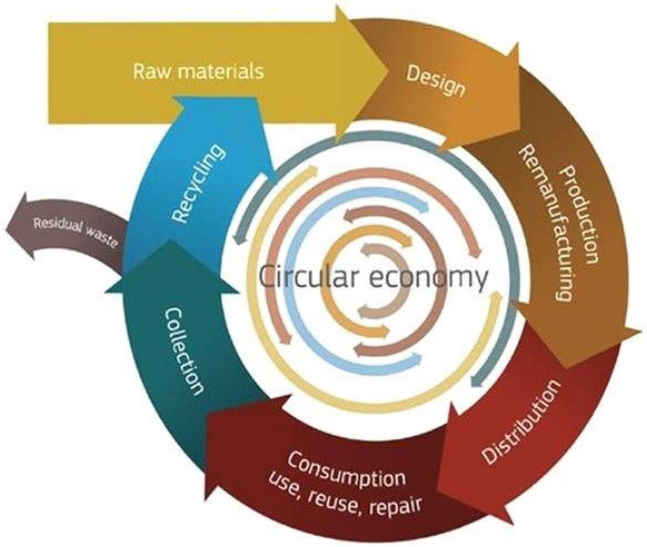
„Moving towards a more circular economy is essential to deliver the resource efficiency agenda established under the Europe 2020 Strategy for smart, sustainable and inclusive growth"

WHAT WE SHOULD DO?

We should convert our economy to Circular Economy (CE) model

the added value is kept in products for as long as possible

waste is eliminated



Source: Towards a circular economy: A zero waste programme for Europe (COM no. 398, 2014); Closing the loop - An EU action plan for the Circular Economy (COM no. 614, 2015)

FOCUS ON CRITICAL RAW MATERIALS IN CIRCULAR ECONOMY

1. Critical raw materials (CRMs) are not used to their full extent as part of the circular economy and there are several improvement opportunities to reuse and recycle these materials.

2. For several economic sectors in the EU, the use of critical raw materials is far from being fully circular.

3. The gaps are due to various factors, including the loss of materials during collection and recycling of end-of-life products.

Need for improved legislative framework, further research and better data

Source: ec.europa.eu/jrc/en/news/are-we-circular-yet-focus-critical-raw-materials-circular-economy

BEFORE CIRCULAR ECONOMY? PHOSHORUS

2013: Phosphorus

EUROPEAN COMMISSION

Brussels, 8.7.2013
COM(2013) 517 final

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Consultative Communication on the Sustainable Use of Phosphorus

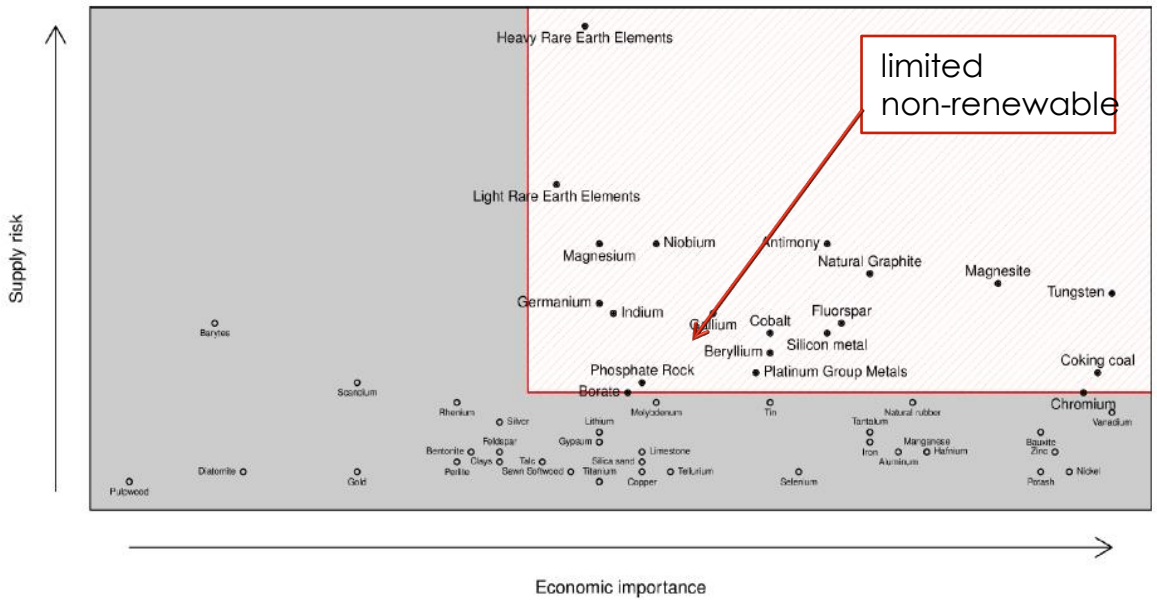
- implementation of the EU restrictions on the sustainable usage of P - sources in economy

„purpose of this Consultative Communication is to draw attention to the sustainability of phosphorus use and to initiate a debate on the state of play and the actions that should be considered"

Source: Consultative Communication on the Sustainable Use of Phosphorus (COM no. 517, 2013); ec.europa.eu/jrc/en/news/are-we-circular-yet-focus-critical-raw-materials-circular-economy

PHOSPHORUS (P) AS CRITICAL RAW MATERIAL

2014: Phosphate rock



Source: Report on critical raw materials for the EU, May 2014 (COM 2014, 297); criticalrawmaterials.org/phosphate-rock/

2017: Phosphate rock & Phosphorus

End-of-life recycling input rate

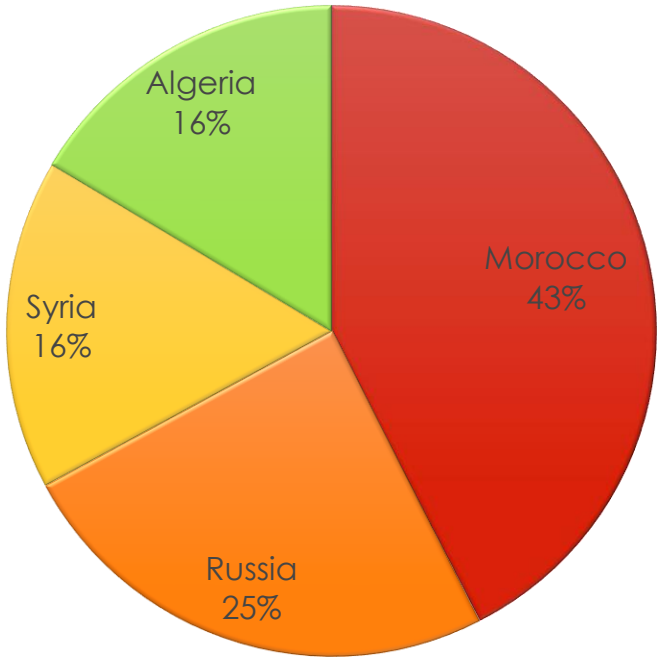
17%

0%

Source: Report on critical raw materials for the EU (COM 490, 2017);

WHO WE NEED?
IMPORTERS OF P SOURCES TO THE EU

Phosphate rock



(average 2010-2014)

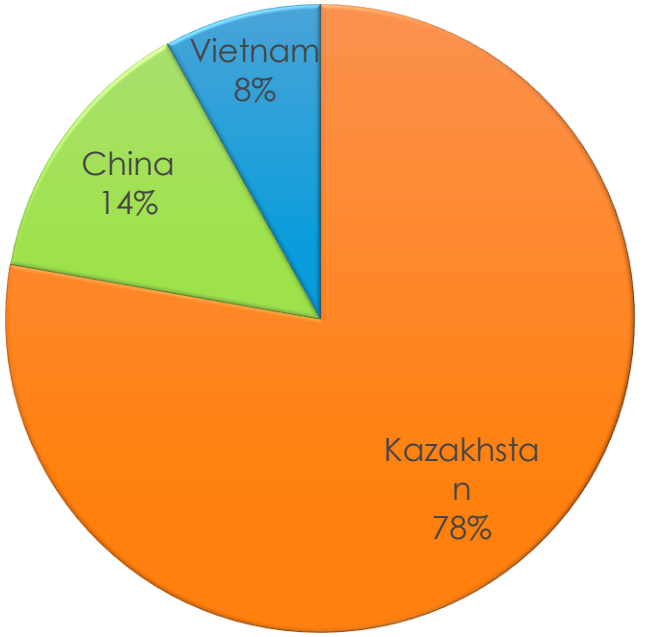
Import reliance rate

88%

100%

P production is carried out only in Finland, but it is less than 1% of the world's phosphate resources which is 287.5 billion tonnes

Phosphorus

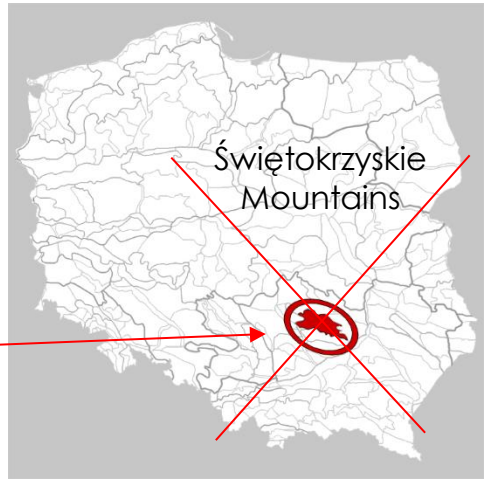


(average 2010-2014)

Source: Report on critical raw materials for the EU (COM 490, 2017)

SOURCES OF PHOSPHORUS IN POLAND

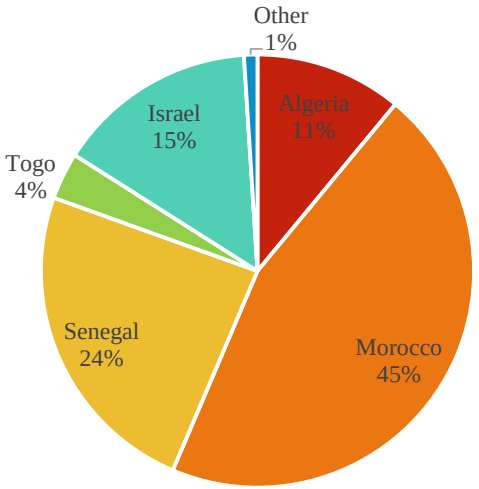
In Poland, there is no production of phosphates at this moment.



No primary sources of phosphorus!

Exporters of phosphate rock and phosphorus to Poland in 2016

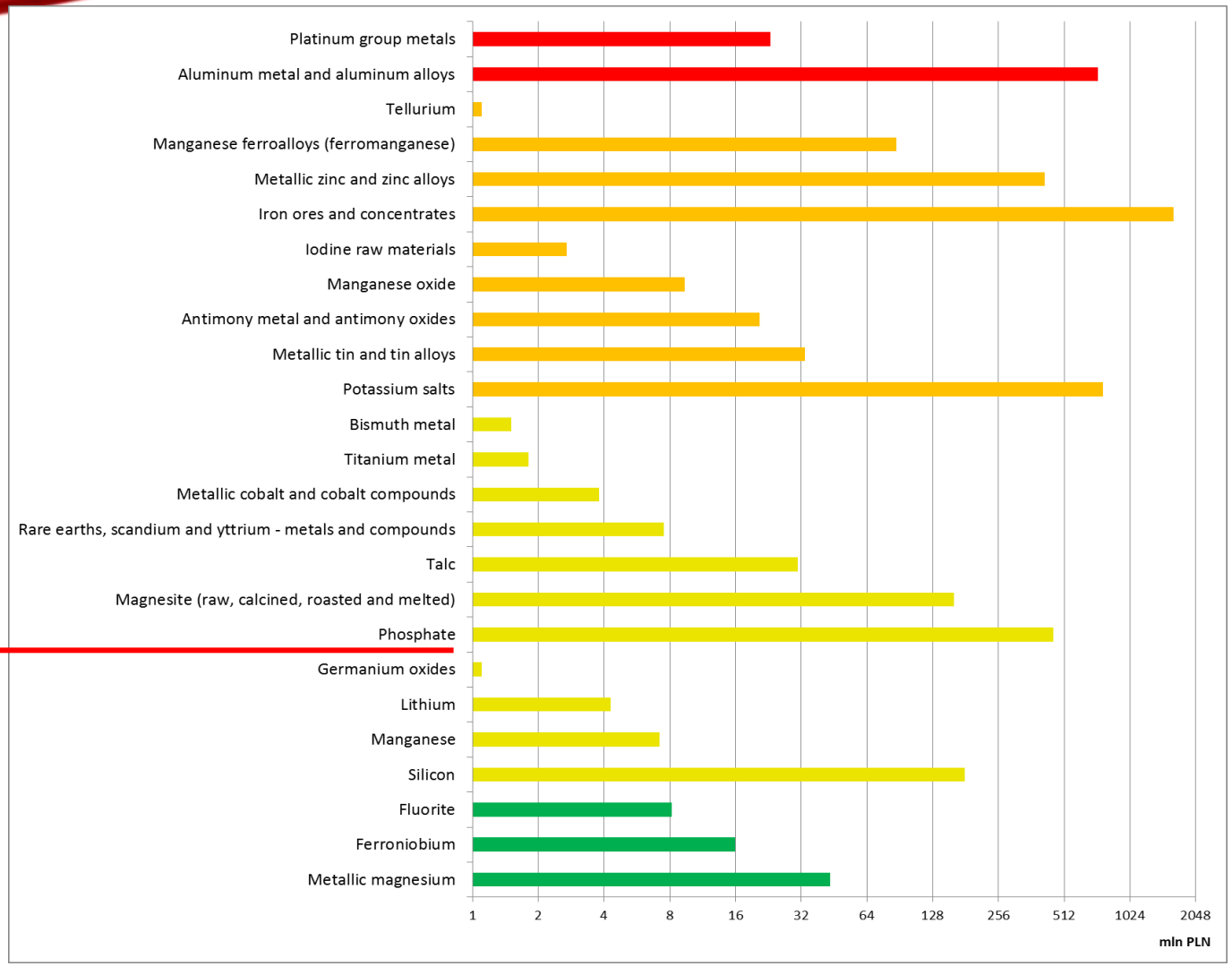
Source: (Environment, 2017)



A consequence of fact that Poland has no P mines, it is highly dependent on the import of phosphate ore.

Demand for phosphorus-bearing raw materials is satisfied entirely by imports - phosphate concentrates (32–33% P2O5).

KEY NON-ENERGY RAW MATERIALS FOR POLISH ECONOMY

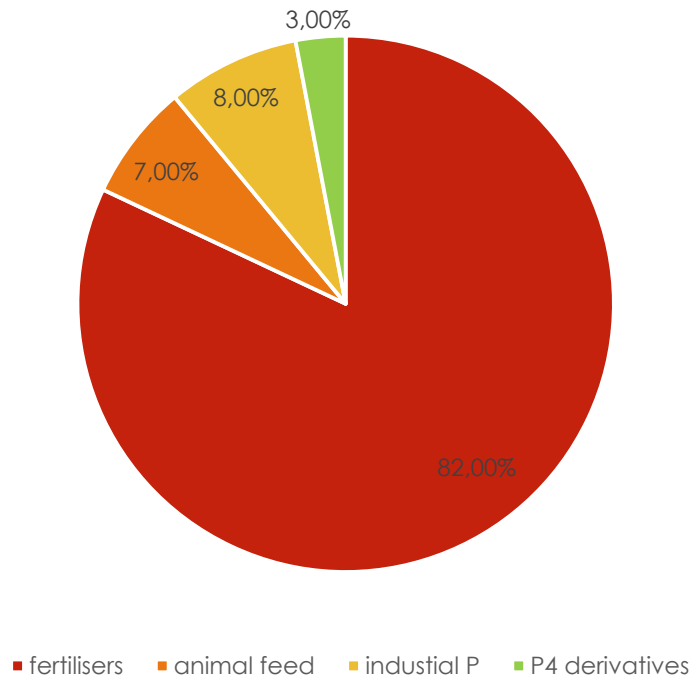


high demand
+
critical raw material
+
potential resource base

Source: Kulczycka i in. 2015 – Kulczycka, J., Galos, K., Pietrzyk-Sokulska, E., Koneczna, R. i Lewicka, E. 2015. Przygotowanie analizy: Identyfikacja surowców kluczowych dla polskiej gospodarki. Warszawa, Ministerstwo Rozwoju (Gospodarki) (materiały niepublikowane).

WHY WE NEED P SOURCES?

P demand



> 90% of P compounds produced are used in the agricultural, feed and food industries

P consumed in food by global population
$3*10^6$ tonnes P/year

We need P to life!

Source: www.decroo.belgium.be/en/turn-farmers-south-entrepreneurs-new-strategic-policy-note-agriculture-and-food-security; research.nelson-hall.com/blog/?avpage-views=blog&type=post&post_id=697

OTHER P APPLICATIONS

FIRE STARTER

Red phosphorus is chiefly used on making matches

White phosphorus is used in making incendiary (fire causing) bombs, tracer bullets and for producing smoke screen.

RAT KILLER

White phosphorus and zinc phosphate are mainly used as a poison for rats

DETERGENTS

This use is being reduced at very high rate

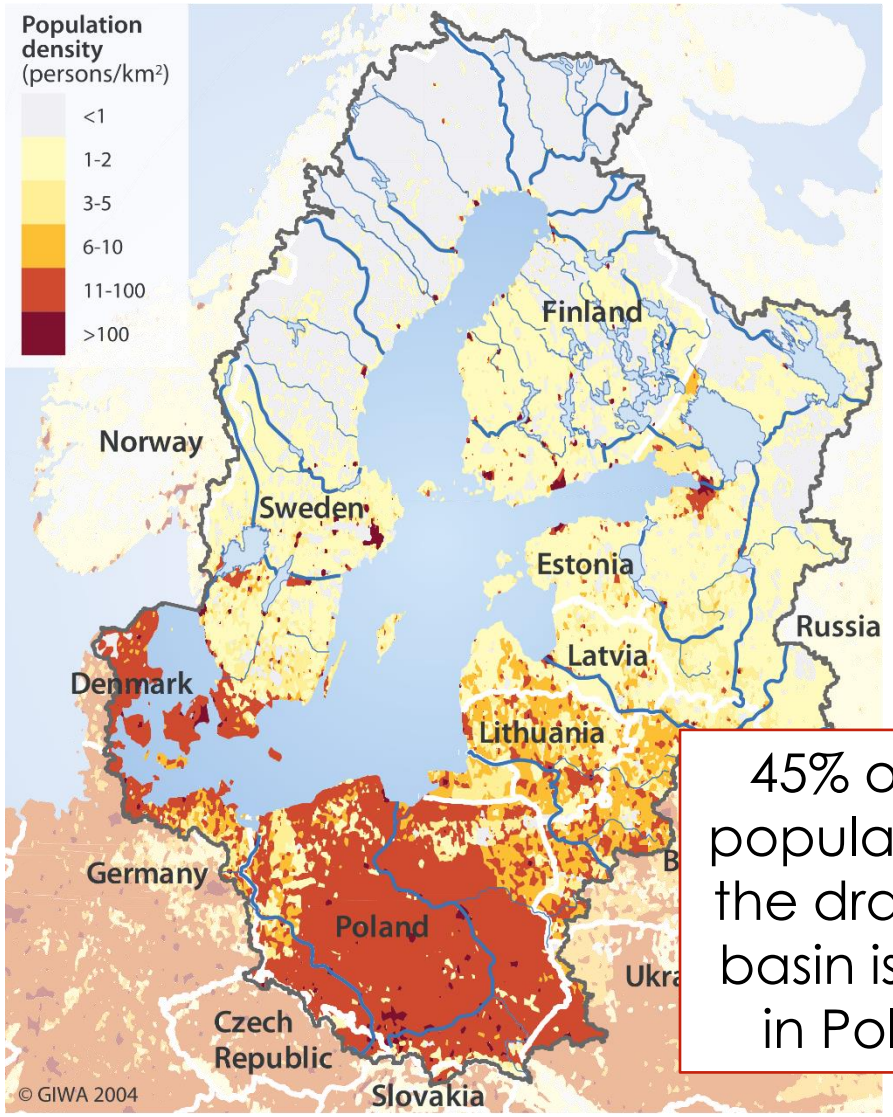
Phosphorus is also used in steel manufacture and in the production of phosphor bronze

Source: sciencestruck.com/red-phosphorus-uses; alwaght.com; www.wisegeek.com/what-are-the-different-industrial-uses-of-phosphorus.htm; www.stringjoy.com/phosphor-bronze-vs-80-20-bronze-acoustic-guitar-string-types/

THE INCLUSION OF PHOSPHATES IN THE EU CRMS LIST WILL DRIVE:

- EU policies to promote sustainable phosphorus management - Circular Economy (CE) model
- data gathering on P resources and use
- research and development (R&D)
- P recovery and recycling policies

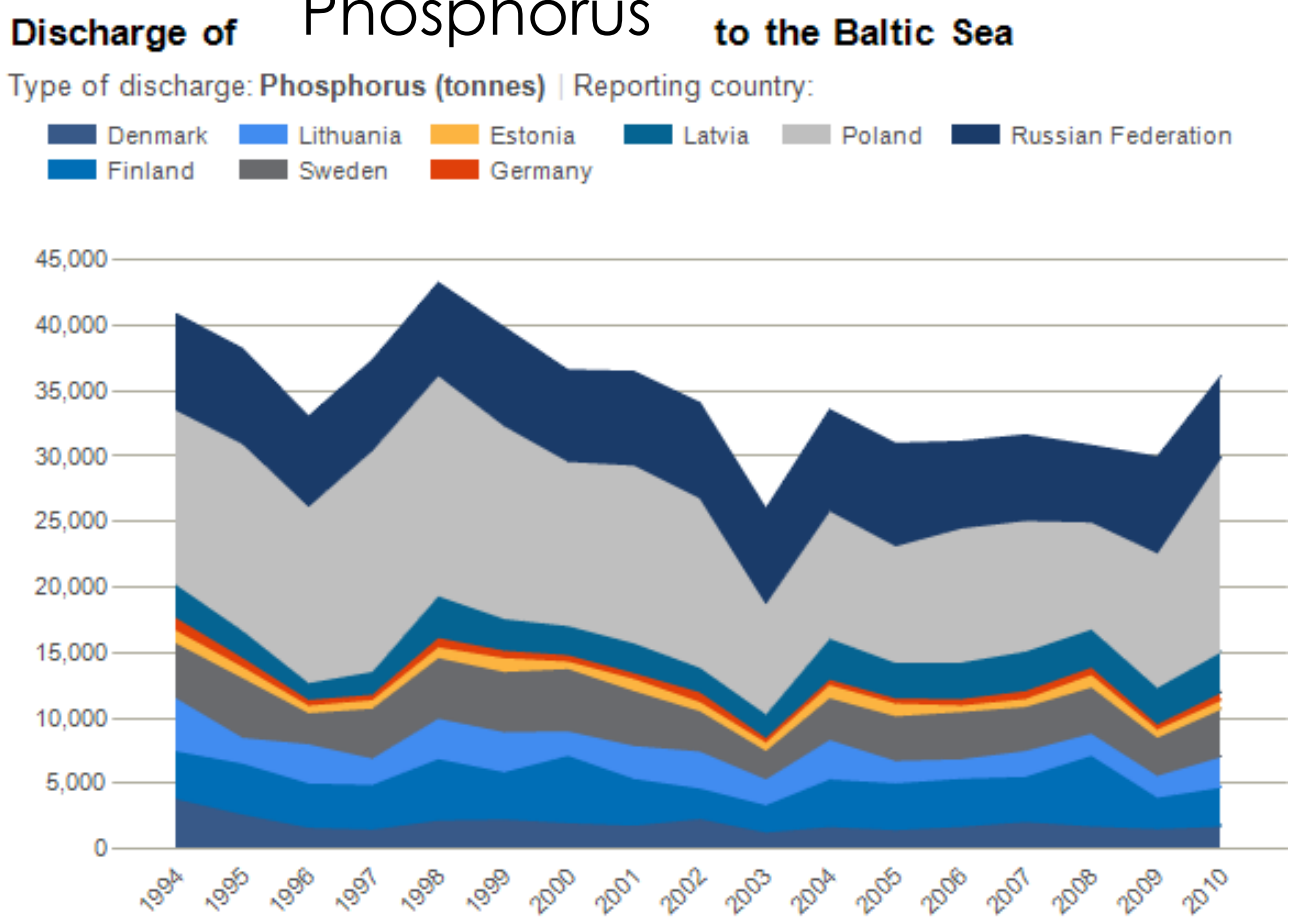
BALTIC REGION



45% of the population of the drainage basin is living in Poland

Source: www.helcom.fi/baltic-sea-trends/eutrophication

DISCHARGE OF PHOSPHORUS TO THE BALTIC SEA



As a consequence of:

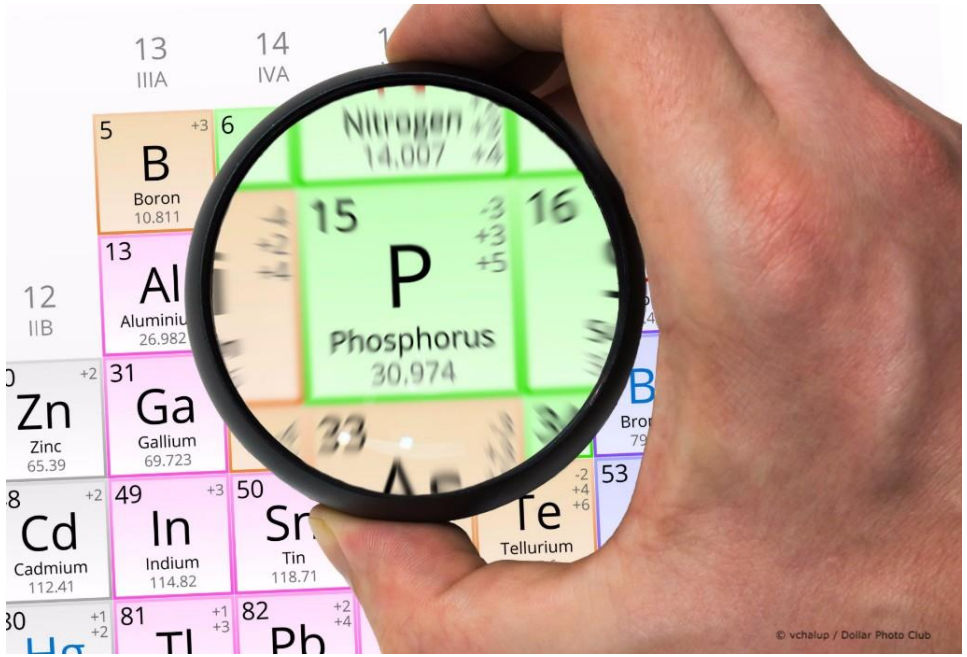
- an extensive runoff from intensive agricultural activities;
- the high population in southern part of the drainage basin,

the largest source of phosphorus by far is from Poland – up to 30% of the total.

Source: www.norden.org/en/nordic-council-of-ministers/ministers-for-co-operation-mr-sam/sustainable-development/indicators-for-sustainable-development-1/viable-ecosystems/discharge-of-nitrogen-and-phosphorus-to-the-baltic-sea/discharge-of-phosphorus-1000-tonnes-into-the-baltic-sea

CONCLUSION

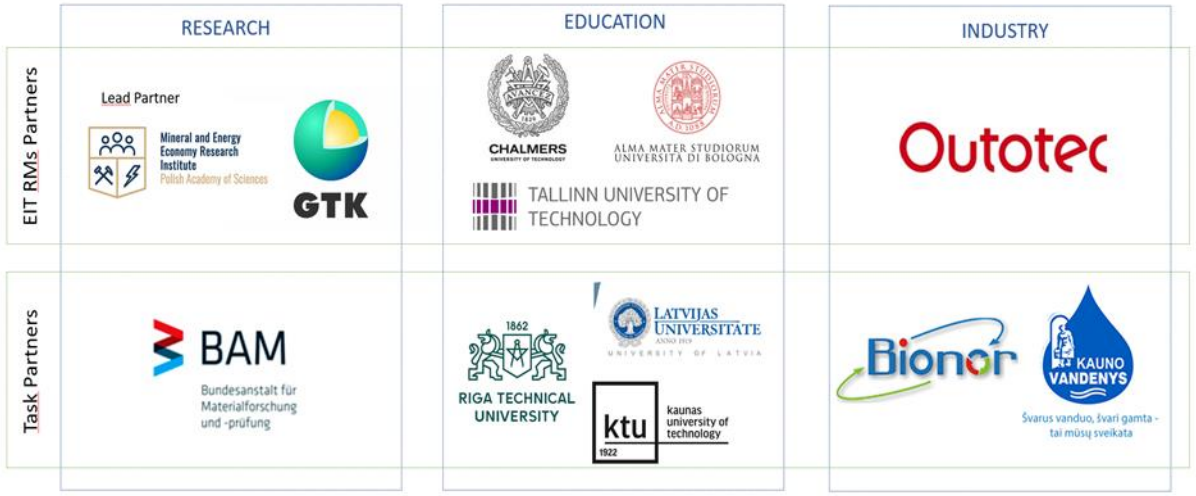
DEVELOPMENT OF SOLUTIONS FOR THE SUSTAINABLE USE OF PRIMARY AND SECONDARY SOURCES,
BASED ON THE CIRCULAR ECONOMY PRINCIPLES IS NEEDED!



SUSTAINABLE P USAGE MUST BE TRANS-NATIONAL

Project
Sustainable Management of Phosphorus in Baltic countries (InPhos)

project no. 17022 (2018-2019), that is financed by the EIT Raw Materials – body of EU



The main goal of the InPhos project is to develop a Phosphorus Strategy for the Baltic Region

Strategic InPhos objectives consist of the following:

1) identification of best management practices of sustainable phosphorus usage existing in developed countries,
2) identification of the recovery potential for phosphorus in the Baltic region,
3) transfer of knowledge and design of solutions for the sustainable use of phosphorus in the Baltic region,
4) promotion of the closing of the phosphorus cycle in the Baltic region,
5) building of a 'phosphorus responsible society',
6) educational development- improvement of the skill basis of the knowledge triangle in the Baltic region.

CIRCULAR ECONOMY ASSUMPTIONS IN THE PHOSPHORUS MANAGEMENT

RECOMMENDED DIRECTIONS

- Legal recommendations
- Financial support
- Organisational recommendations
- Technical and environmental recommendations
- Social aspects - awareness, behavior

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LEGAL RECOMMENDATIONS (1)

EU - SD

- implementation of the EU restrictions on the sustainable usage of P - sources in economy(COM no. 517, 2013)

CE action plan

- Promotion of secondary sopurces of P in fertiliser industry

EUROPEAN COMMISSION

Brussels, 17.3.2016
COM(2016) 157 final

2016/0084 (COD)

Circular Economy Package

Proposal for a

REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

laying down rules on the making available on the market of CE marked fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009

Recycling of domestic waste, in line with a CE model, could potentially cover about 20-30% of EU's demand of phosphate fertilisers

Source:Consultative Communication on the Sustainable Use of Phosphorus (COM no. 517, 2013); Circular Economy Package – Proposal for laying down rules on the making available on the market of CE marked fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 (COM no. 157, 2016)

LEGAL RECOMMENDATIONS (2)

Development of regulation proposals and recommendations for policy makers

Official recommendations - the Environment Committee of the Polish Senate

1st Opinion 17th of March 2016 on the innovative use of wastewater as a source of energy and resources - a dynamic development of research on **P recovery from wastewater and sewage sludge** in Polish conditions was highlighted as the expected way forward in future years

2nd Opinion 14th of March 2017 on the inclusion of sewage sludge in the circular economy - the importance of investments in new and innovative solutions in the wastewater sector was identified as the main driving force in the transition to a circular economy model in Poland

3th Opinion 6th of December 2017 on the protection of the Baltic Sea against pollution from sewage sludge in the context of the HELCOM recommendations - recirculation of nutrients, especially phosphorus, from sewage sludge as a recommended route towards better use of their valuable properties and energy potential, and to manage sediments in a safe, effective and sustainable manner

Source: www.sejm.gov.pl

LEGAL RECOMMENDATIONS (3)

Development of law restrictions on the recovery of P from various waste streams

Switzerland

- First country in the world make phosphorus recovery and recycling from sewage sludge and slaughterhouse waste obligatory (2016)

Germany

- German sewage sludge ordinance (AbfKlärV) makes phosphorus recovery obligatory for most of Germany's WWTPs either by P-recovery from the sludge or by mono-incineration and recovery from sewage sludge incineration ash (2018)

Source: mapofeurope.com/map-of-the-baltic-region/

CIRCULAR ECONOMY ASSUMPTIONS IN THE PHOSPHORUS MANAGEMENT

RECOMMENDED DIRECTIONS

- Legal recommendations
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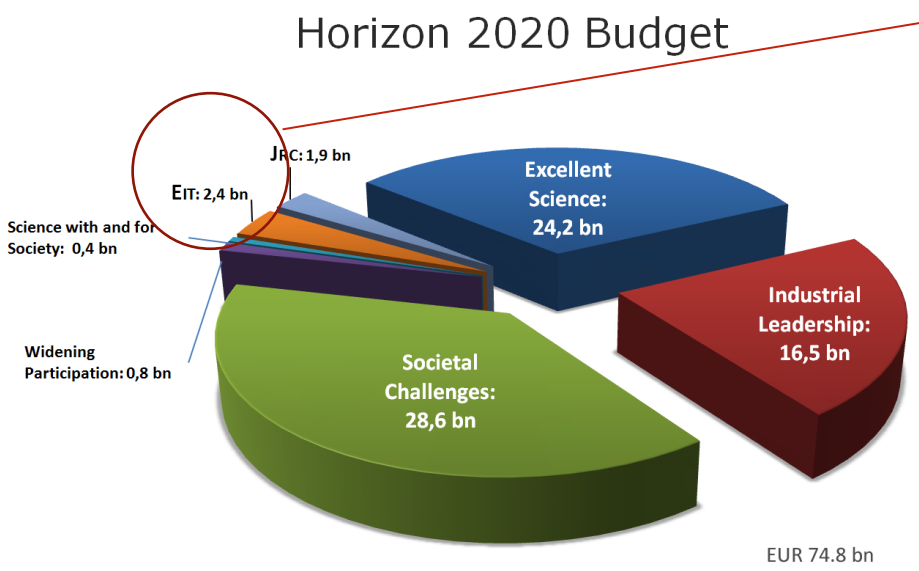
FINANCIAL SUPORT (1)

Development of financial tools supporting research and development in the area of CRMs sources management, consumption and recycling

Horizon 2020
is the biggest EU Research and Innovation programme ever with nearly €80 billion of funding available over 7 years (2014 to 2020) – in addition to the private investment that this money will attract.



eit | European Institute of Innovation & Technology

eit RawMaterials
Connecting matters

Vision
„*Developing raw materials into a major strength for Europe*"

FINANCIAL SUPORT (2)

Development of the programs supporting the research and investment in P recovery technologies

Up-scaling projects

Project: PhosForce. **Market ready technologies** for P-recovery from municipal wastewater (2018-2021)

Narodowe Centrum Badań i Rozwoju **Applied Research Program**

Project Environmentally-friendly technology for sewage sludge ash utilization as a source of fertilisers and construction materials (2012-2015)

Source: eitrawmaterials.eu

FINANCIAL SUPORT (3)

Development of the programs supporting the research and investment in P recovery technologies

Narodowe Centrum Badań i Rozwoju

Sectoral R&D program: **Innovative recycling**
Call 2018: openning on July 23, 2018
Funding: 50 mln PLN
Info: www.ncbr.gov.pl

Source: ncbir.pl

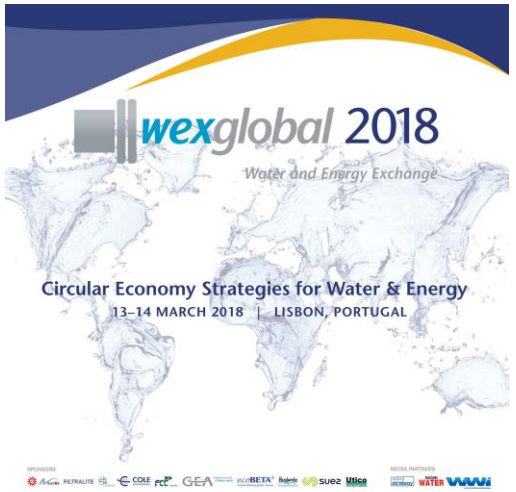
FINANCIAL SUPORT (4)

Development of the tools supporting the commercialisation of the research and implementation of the nutrients recovery technologies into the market

P - recovery technologies in Europe

Project 'Modernisation and Extension of WWTP Jarocin' 60 million EUR, supported by co-financing from the EU

WINNER in the category „Innovation in the Circular Economy"



Source: www.batchgeo.com/map/0f9d56a3aa57a51379a3cb23af27d202

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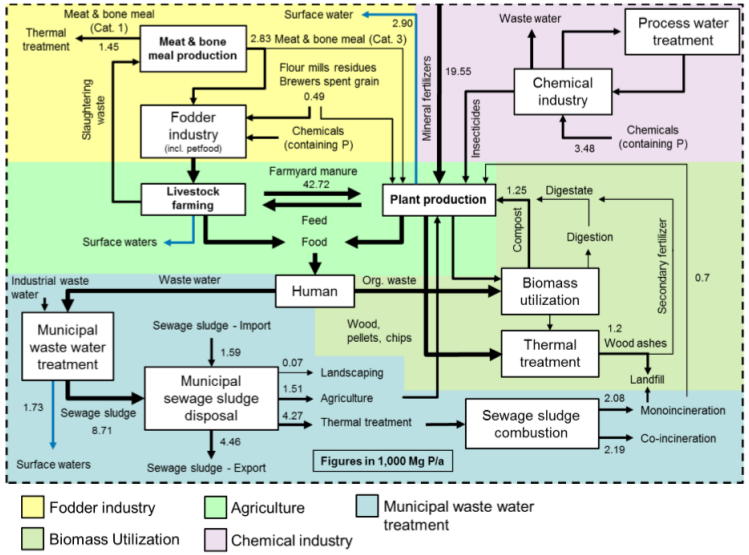
ORGANISATIONAL RECOMMENDATIONS (1)

Transfer of knowledge and design of solutions for the sustainable use of P on regional and national level, based on existing best management practices of P usage in developed countries

BAVARIAN PHOSPHORUS STRATEGY

Phosphorus material flow model for Bavaria



Recommendations for the Bavarian Phosphorus Strategy

Technical Recommendations	Political Recommendations	Flanking Recommendations
Implementation of recovery scenarios	Defined targets and control	Expert talk
Promoting incineration of sewage sludge	Mandatory blending	Avoidance of phosphorus effluent
Mono-landfill of ashes	Obligation to recover phosphorus	Support of authorisation
Research and development	Market regulations	Organic farming
Use of animal by-products category 1	Certificate models	Monitoring/ information

Source: phosphorusplatform.eu/images/Conference/ESPC2-materials/Wiesgickli%20poster%20ESPC2.pdf

ORGANISATIONAL RECOMMENDATIONS (2)

Creation of network platform aimed at collaboration on the regional and national level in the area of P management

European Sustainable Phosphorus Platform

DEUTSCHE PHOSPHOR PLATTFORM

BSAG® Baltic Sea Action Group

Nutrient Platforms under development

Flanders (Belgium) - Vlaams Nutrienten Platform
United Kingdom - UK Nutrient Platform
Ireland

Polish network

IATI Autostrada Technologii i Innowacji

Competence Center:
PL: Centrum Surowców mineralnych, Pierwiastków Krytycznych (CRMs)

IMBM Autostrada Technologii i Innowacji Monday Business Meeting

IATI Monday Business Meetings - monthly

ORGANISATIONAL RECOMMENDATIONS (3)

Development of mapping service dedicated to organising detailed information on secondary P sources in the Baltic Sea region

P - recovery technologies in Europe

TASK 2: IDENTIFICATION OF THE RECOVERY POTENTIAL FOR PHOSPHORUS IN THE BALTIC REGION – **creation of a GIS database (mapping service)** with specific information on the amount of P derived from primary and secondary sources, the technical possibilities for P recovery in the Baltic region, the location of P-related installations, as well as any regulatory aspects of these jurisdictions, and the existing projects, activities, and programs involving P-issues

Source: www.batchgeo.com/map/0f9d56a3aa57a51379a3cb23af27d202

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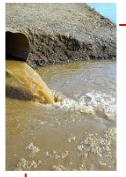
TECHNICAL AND ENVIRONMENTAL RECOMMENDATIONS (1)

Secondary sources of phosphorus



wastewater – municipal/ industial

sewage sludge

sewage sludge ash

meat and bone meal

pig slurry

biomass

industrial waste

TECHNICAL AND ENVIRONMENTAL RECOMMENDATIONS (2)

Conducting research and development focused on the P management and recovery

P recovery from phosphogypsum waste

Grupa Azoty Zakłady Chemiczne "Police" S.A.

INS Instytut Nowych Syntez Chemicznych

Politechnika Wrocławska

Phosphogypsum waste to fartiliser

Source:www.kierunekchemia.pl/artykul,6089,nawozy-z-odpadow.html

P recovery from industrial waste – leachete from phosphogypsum waste

FOSFORY GRUPA PUŁAWY

began using phosphate resources from the storage reservoir in the heap Wiślinka (2014)

P recovered from leachate was reused for the production of fertilizers such as Amofoska and Superphosphate

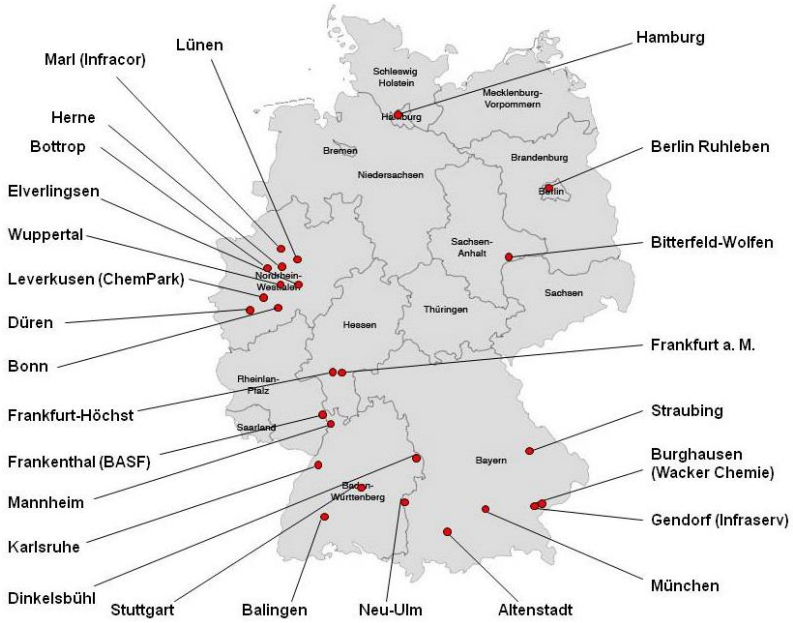
Source:blog.pulawy.com/pl/fosfory-wyprodukuja-nawozy-odpadow/

TECHNICAL AND ENVIRONMENTAL RECOMMENDATIONS (3)

Identification of the P recovery potential from different waste streams

(the performance of installations across the country/ region and the availability of recycled P)

BAM
Bundesanstalt für Materialforschung und -prüfung



Inventory is needed for municipal and industial P-rich waste streams!

P-RICH WASTE STREAMS IN POLAND

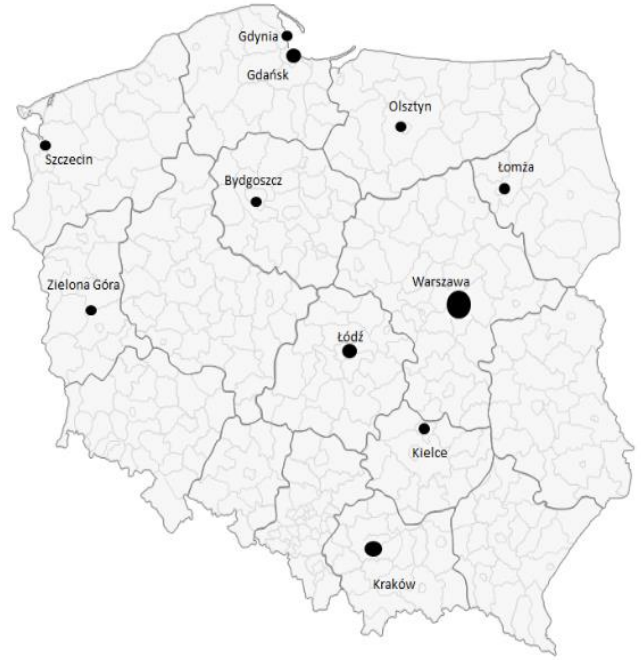
P-rich waste generation: municipal and industrial sludges: 947.2 thous. Mg of dry solid waste in 2016, sewage sludge ash 45 thous.Mg /year or biomass ash 4.2 million Mg/year

4 thous.Mg of P /year

SSA generated in Polish plants

Sewage sludge incineration plant	2011		2012		2013		2014	
	incinerated sludge	SSA	incinerated sludge	SSA	incinerated sludge	SSA	incinerated sludge	SSA
	(Mg)							
Warsaw	*	*	59,794	4,332	99,219	8,712	111,293	8,929
Cracow	65,887	4,340	47,817	2,761	63,902	5,231	>70,000	>4,800
Kielce	1,174	26	13,010	721	17,043	1,152	14,534	662
Lodz	*	2,993	*	3,037	*	2,132	*	>2,591
Gdynia	4,700	1,872	5,611	2,374	6,679	2,650	5,828	2,369
* no data								

Polish mono-incineration plants



Source: Smol et al., 2016

TECHNICAL AND ENVIRONMENTAL RECOMMENDATIONS (4)

- Environmental assessment of engineering solutions dealing with P recovery from different waste streams

Deliverable D 9.2
Life Cycle Assessment of selected processes for P recovery from sewage sludge, sludge liquor, or ash

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SOCIAL ASPECTS (1)

Building of a ‘Phosphorus Responsible Society’

educating the public about the diversity of P sources and the potential of good P management

developing business ideas related to this resource

fostering circular thinking

SOCIAL ASPECTS (2)

Building of a ‘Phosphorus Responsible Society’

Mineral and Energy Economy Research Institute
Polish Academy of Sciences

Seminars with stakeholders

SOCIAL ASPECTS (3)

Promotion of the best management practices of sustainable phosphorus usage among local farmes

sustainable use of fertilisers

Source: www.polskieradio.pl/42/3723/Artykul/1185674,KRUS

SOCIAL ASPECTS (4)

Promotion of an interdisciplinary systems thinking approach

Seminars with students

Annual Conference "Young Researchers' Innovative Ideas: Science Start-Ups in the Industry"

IATI
Autostrada Technologii i Innowacji

Mineral and Energy Economy Research Institute
Polish Academy of Sciences

Source: www.iati.pl

SOCIAL ASPECTS (5)

Promotion of an interdisciplinary systems thinking approach by various awareness-raising activities

AGH

Workshops for children

- Workshop I ,,Exploring a Circular World"
- Workshop II ,,Researcher is a Wonderful Profession"

Mineral and Energy Economy Research Institute
Polish Academy of Sciences

Workshops for students

- Seminar “Towards Circular Economy in waste, water and sewage management” organized by the Mineral and Energy Economy Research Institute of the Polish Academy of Sciences and IATI as part of the InPhos project (EIT Raw Materials)
- Training course for Master's students – raw materials in a circular economy – project „Masters course in circular economy for materials processing - MC-CEMP” (EIT Raw Materials, 2018-2020)

SOCIAL ASPECTS (6)

18-19 SEPTEMBER 2018 CRACOW - POLAND

WEB: konferencja-pan.pl/en/

NFOŚiGW

Mineral and Energy Economy Research Institute
Polish Academy of Sciences

Participation in the conference is free of charge!

WORKSHOP

Project BEST – Better Efficiency for Industrial Sewage Treatment
Międzynarodowe seminarium poświęcone odzyskowi fosforu
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