CIRCULAR ECONOMY ASSUMPTIONS IN THE PHOSPHORUS MANAGEMENT IN THE BALTIC REGION

Dr Marzena Smol
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!

“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

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

BEFORE CIRCULAR ECONOMY?
PHOSPHORUS

2013: 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"
PHOSPHORUS (P) AS CRITICAL RAW MATERIAL

2014: Phosphate rock

limited non-renewable

2017: Phosphate rock & Phosphorus

End-of-life recycling input rate

17%  0%

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

Source: Report on critical raw materials for the EU (COM 490, 2017);
WHO WE NEED? IMPORTERS OF P SOURCES TO THE EU

**Phosphate rock**

- **Morocco**: 43%
- **Russia**: 25%
- **Syria**: 16%
- **Algeria**: 16%

**Import reliance rate**

- **88%**

**Phosphorus**

- **Kazakhstan**: 78%
- **China**: 14%
- **Vietnam**: 8%

**Import reliance rate**

- **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.

Source: Report on critical raw materials for the EU (COM 490, 2017)
In Poland, there is no production of phosphates at this moment.

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).

Exporters of phosphate rock and phosphorus to Poland in 2016

Source: (Environment, 2017)
KEY NON-ENERGY RAW MATERIALS FOR POLISH ECONOMY

- Platinum group metals
- Aluminum metal and aluminum alloys
- Tellurium
- Manganese ferroalloys (ferromanganese)
- Metallic zinc and zinc alloys
- Iron ores and concentrates
- Iodine raw materials
- Manganese oxide
- Antimony metal and antimony oxides
- Metallic tin and tin alloys
- Potassium salts
- Bismuth metal
- Titanium metal
- Metallic cobalt and cobalt compounds
- Rare earths, scandium and yttrium - metals and compounds
- Talc
- Magnesite (raw, calcined, roasted and melted)
- Phosphate
- Germanium oxides
- Lithium
- Manganese
- Silicon
- Fluorite
- Ferronickel
- Metallic magnesium

high demand + critical raw material + potential resource base

WHY WE NEED P SOURCES?

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

P demand

- Fertilisers: 92.00%
- Animal feed: 7.00%
- Industrial P: 8.00%
- P4 derivatives: 3.00%

P consumed in food by global population

3*10^6 tonnes P/year

We need P to life!

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.

DETERGENTS
This use is being reduced at very high rate

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

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

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
Many human activities exert pressure on Baltic environmental status.

Eutrophication is one of the main threats to the biodiversity of the Baltic Sea and is caused by excessive inputs of nutrients to the marine environment.

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

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

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

CONCLUSION
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)

- Implementation of the EU restrictions on the sustainable usage of P-sources in economy (COM no. 517, 2013)
- Promotion of secondary sources of P in fertiliser industry

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

Development of regulation proposals and recommendations for policy makers

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

2\textsuperscript{nd} Opinion 14\textsuperscript{th} 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.

3\textsuperscript{th} Opinion 6\textsuperscript{th} 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 (AbfKlarV) 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/
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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.

Vision
„Developing raw materials into a major strength for Europe“
Development of the programs supporting the research and investment in P recovery technologies

**Up-scaling projects**


**Source:** eitrawmaterials.eu
Development of the programs supporting the research and investment in P recovery technologies

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

Source: ncbir.pl
FINANCIAL SUPPORT (4)

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

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/0f9d56a3aa57a51379a3cb23af27d2d02
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- Legal recommendations
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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**

Recommendations for the Bavarian Phosphorus Strategy

Source: phosphorusplatform.eu/images/Conference/ESPC2-materials/Wiesgickli%20poster%20ESPC2.pdf
Creation of network platform aimed at collaboration on the regional and national level in the area of P management

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

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

IATI Monday Business Meetings - monthly
Development of mapping service dedicated to organising detailed information on secondary P sources in the Baltic Sea region

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/09d56a3aa57a51379a3cb23af27d202
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Secondary sources of phosphorus

- wastewater – municipal/industrial
- 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

P recovery from industrial waste – leachate from phosphogypsum waste

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-wyprodukuj-naowozy-odpadow/

Source: www.kierunekchemia.pl/artykul.6089,nawozy-z-odpadow.html
Identification of the P recovery potential from different waste streams
(the performance of installations across the country/region and the availability of recycled P)
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

<table>
<thead>
<tr>
<th>Sewage sludge incineration plant</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
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<tr>
<td></td>
<td>incinerated sludge</td>
<td>SSA</td>
<td>incinerated sludge</td>
<td>SSA</td>
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<td>Warsaw</td>
<td>*</td>
<td>*</td>
<td>59,794</td>
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<tr>
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<td>Gdynia</td>
<td>4,700</td>
<td>1,872</td>
<td>5,611</td>
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</tr>
</tbody>
</table>

* no data

Source: Smol et al., 2016
• Environmental assessment of engineering solutions dealing with P recovery from different waste streams
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SOCIAL ASPECTS (1)

Building of a ‘Phosphorus Responsible Society’

- Educating the public about the diversity of phosphorus sources and the potential of good phosphorus management
- Developing business ideas related to this resource
- Fostering circular thinking
SOCIAL ASPECTS (2)

Building of a ‘Phosphorus Responsible Society’

Seminars with stakeholders
Promotion of the best management practices of sustainable phosphorus usage among local farmers

Source: www.polskieradio.pl/42/3723/Artykul/1183674.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”

Source: www.iati.pl
SOCIAL ASPECTS (5)

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

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

- 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)

Participation in the conference is free of charge!
WORKSHOP
Project BEST – Better Efficiency for Industrial Sewage Treatment
Międzynarodowe seminarium poświęcone odzyskowi fosforu
12.06.2018 Gdańsk

Dr Marzena Smol – Leader of the InPhos project
Mineral and Energy Economy Research Institute
Polish Academy of Sciences
J. Wybickiego 7A str., 31-261 Cracow, Poland
Phone: +48 12 651 38 35
E-mail: smol@meeri.pl
www.min-pan.krakow.pl