European Commission

Research projects on environmental issues related to mining and coal mine closure

Coal regions in transition virtual week

18 November 2020

A few guidelines before we begin

We will use Slido for Q&A! To submit questions:

Step 1:
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Enter the code: CRIT5

Step 3:
Submit your question, vote on other questions!

Please note this meeting will be recorded

If you have any technical issues, send a message via the chat to the host.

Welcome!

Zoe Rasbash

Secretariat of the Initiative for Coal Regions in Transition

Slido.com: CRIT5

Social media: #CoalRegionsEU

Scene setting presentation: the future of the RFCS programme

Lucas Janssen

DG RTD, European Commission

Slido.com: CRIT5

Social media: #CoalRegionsEU

The Research Programme of the Research Fund for Coal and Steel (RFCS)

Just Transition Platform Meeting – Coal Regions in Transition Virtual Week
18 November 2020

European Commission – DG R&I
Directorate D 'Clean Planet'
Unit D3 'Low Emission Future Industries'

EU needs ‘climate and resource frontrunners’ to develop the first commercial applications of breakthrough technologies in key industrial sectors by 2030.

"(...) the Commission will propose a revision of the Regulations on the RFCS in order to enable the use a portion of the European Steel and Coal Community assets in liquidation. This will help with maintaining the annual research programme of at least EUR 40 million as well as to enable the funding of large clean steelmaking R&I breakthrough projects. Research activities in the coal sector will focus on regions in transition in line with the principles of the Just Transition Mechanism."

European Commission

The European Green Deal – COM(2019) 640; The European Green Deal Investment Plan - COM(2020) 21

RFCS Modernisation Package

Currently ongoing revision of three RFCS legal bases

COM(2020) 319

amending
Council Decision
2003/76/EC
on the implementation of
Protocol 37

(DG RTD)

COM(2020) 320

amending
Council Decision
2008/376/EC
on the RFCS programme
and technical guidelines

(DG RTD)

COM(2020) 321

amending
Council Decision
2003/77/EC
on financial guidelines

(DG BUDG)

European Commission

RFCS Modernisation Package: 4 main objectives

Research Fund for Coal & Steel

The European Green Deal

von der Leyen Commission

#EUGreenDeal

To ensure a financial annual allocation to manage RFCS Call for Proposals of at least EUR 40 M

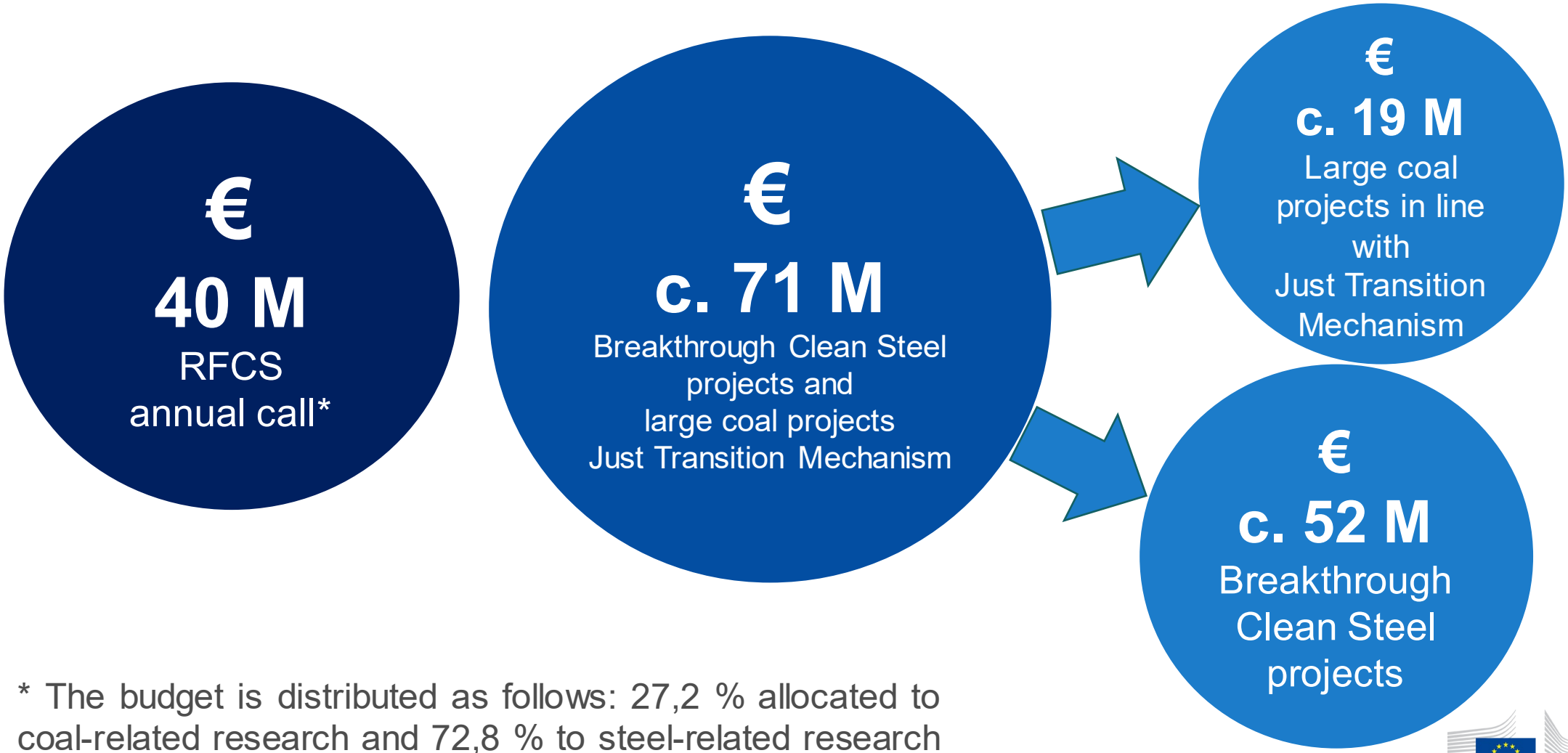
To allocate additional resources for the time period 2021-2027 to respond to new research needs

To modify the financial guidelines managing the assets of the ECSC i.L.

To update the RFCS coal and steel research objectives

European Commission

New annual allocation for 2021-2027



* The budget is distributed as follows: 27,2 % allocated to coal-related research and 72,8 % to steel-related research (Art. 4.2 of Council Decision 2003/76/EC).

European Commission

Newly proposed RFCS coal research objectives

Coal Research Objectives
COM(2020) 320

- Supporting the just transition of the coal sector and regions
- Improving health and safety
- Minimising the environmental impacts of coal mines in transition

European Commission

Running and Finished RFCS project addressing Transition

MERIDA

Management of Environmental RIsks During and After mine closure

Recovery

Recovery of degraded and transformed ecosystem in coalmining-affected areas

European Commission

Thank you

European Commission

MERIDA project

Pedro Riesgo

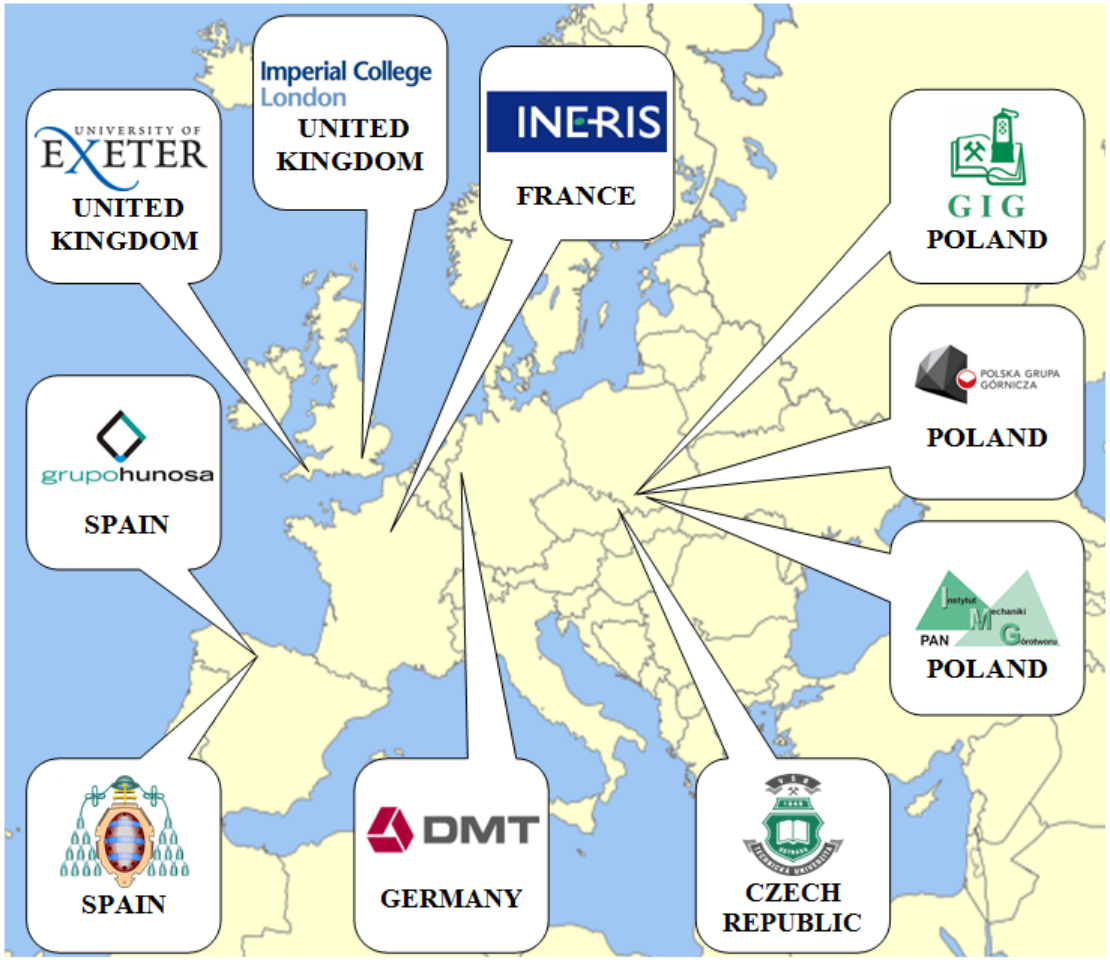
University of Oviedo, Spain

Management of **E**nvironmental **RI**sks **D**uring and **A**fter mine closure

Grant Agreement No. RFCR-CT-2015-00004
15/12/2015 - 15/12/2019

Pedro Riesgo
University of Oviedo
Spain

MERIDA partners

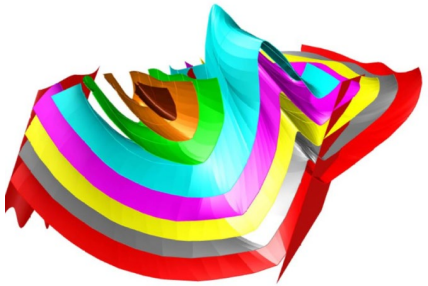


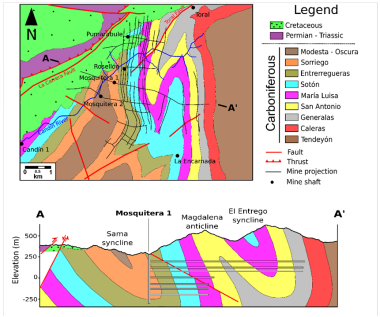
Main goals achieved:

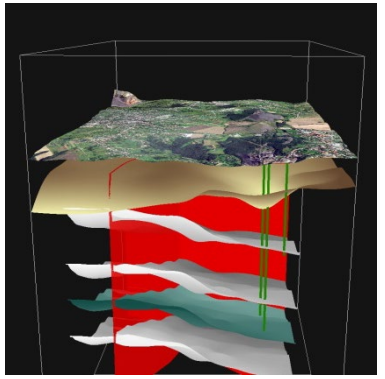
- *Providing specific guidance on the issues that need to be considered when assessing the environmental impacts from underground coal mines at closure and post-closure stages.*
- *Identifying the physical and chemical processes that affect environmental risks during mine closure and post-closure and establishing modelling and monitoring methods that should be implemented.*
- *Developing an integrated risk assessment methodology to decide which risks need treatment, to identify risk treatment strategies and to evaluate them in terms of performance and cost.*
- *Calculating the financial provisions required for closure and post-closure stages for each company, taking all treatment costs into account.*
- *Providing a practical methodology (written up as a technical guidance) that can be used for the evaluation of risk, as well as for selecting the remediation measures in terms of their performance in risk reduction, practical implementation and cost.*

Main RESULTS (Preliminary):

1. A full description of the two European mining sites was achieved. Rydułtowy-Anna Mining Complex (Poland), and Mosquitera and Pumarabule Mines (Spain)



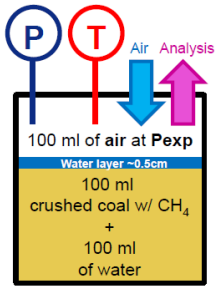


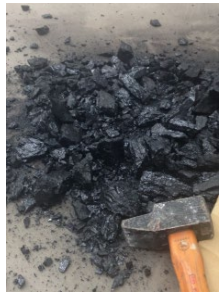


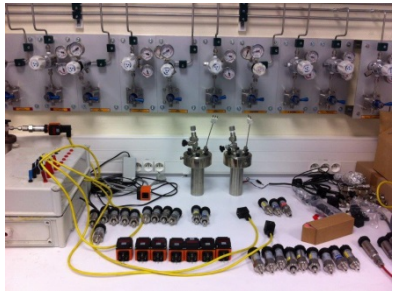
2. Degassing properties of coal samples (i.e. CH_4 emissions) under water pressures, analyzing the influence of water pressure that will evolve during and after mine flooding on CH_4 emissions

RESEARCH PAPER

- *Krause, E., & Karbownik, M. (2019). Tests of methane desorption and emission from samples of hard coal in the context of mine closures through flooding.* ***Journal of Sustainable Mining 18****(3), 127-133* *https://doi.org/10.1016/j.jsm.2019.03.005*

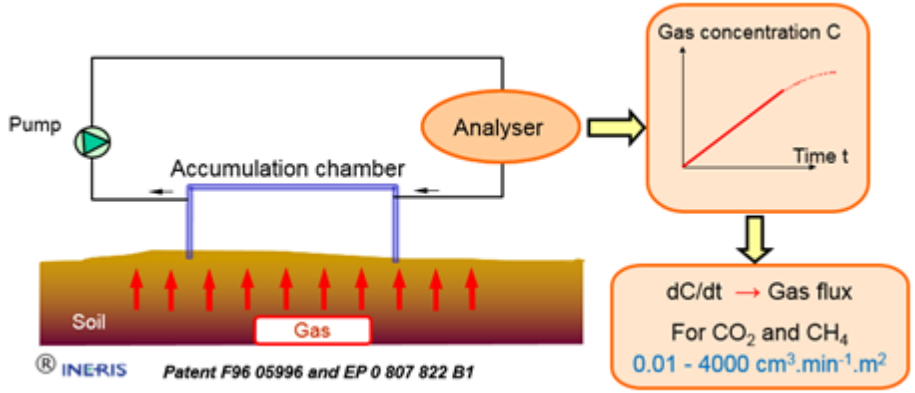






Main RESULTS (Preliminary):

3. A reference guide on soil gas monitoring in coal mining regions, giving guidance, warnings and recommendations.

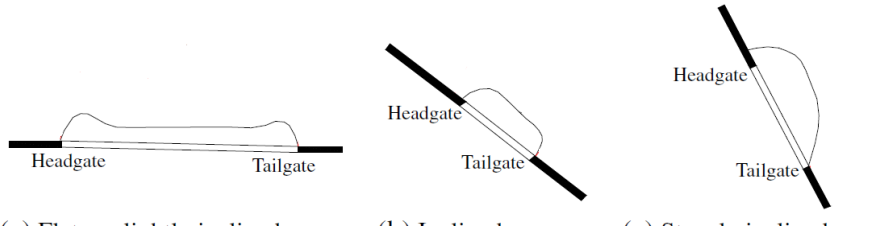


4. A comprehensive report and analysis of coal mine closure risk criteria for ground movement, surface and groundwater pollution and air pollution (including GHG and radon)

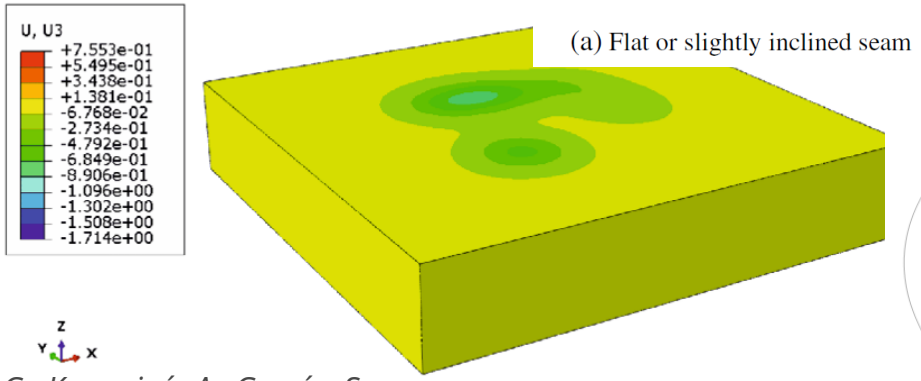
SUBSIDENCE | WATER QUALITY | AIR QUALITY

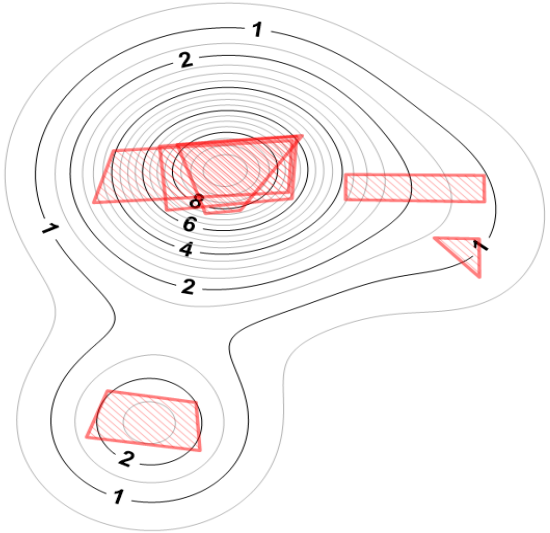
Main RESULTS (Models):

1. Suitable and validated model to proper describe the behaviour of rock mass in a region of flooded coal mines, including not only the behaviour of flooded fractured rock mass but also representing the possible surface deformation.



(a) Flat or slightly inclined seam (b) Inclined seam (c) Steeply inclined seam



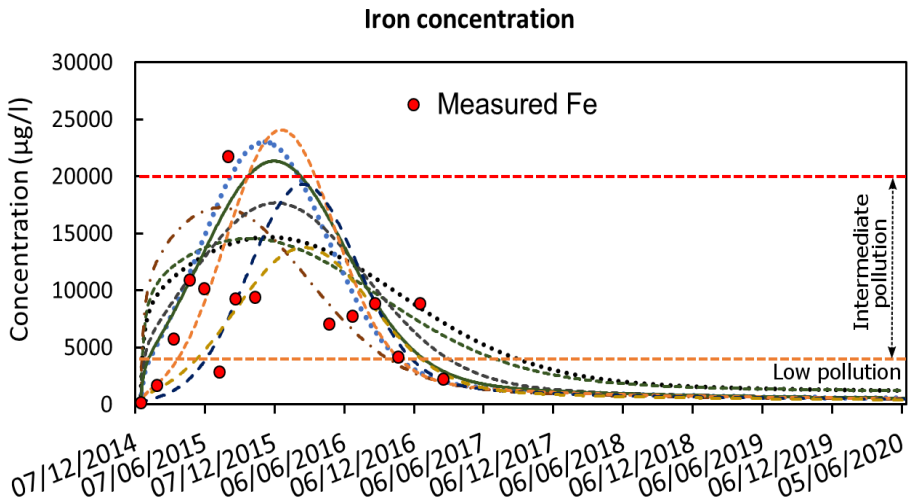


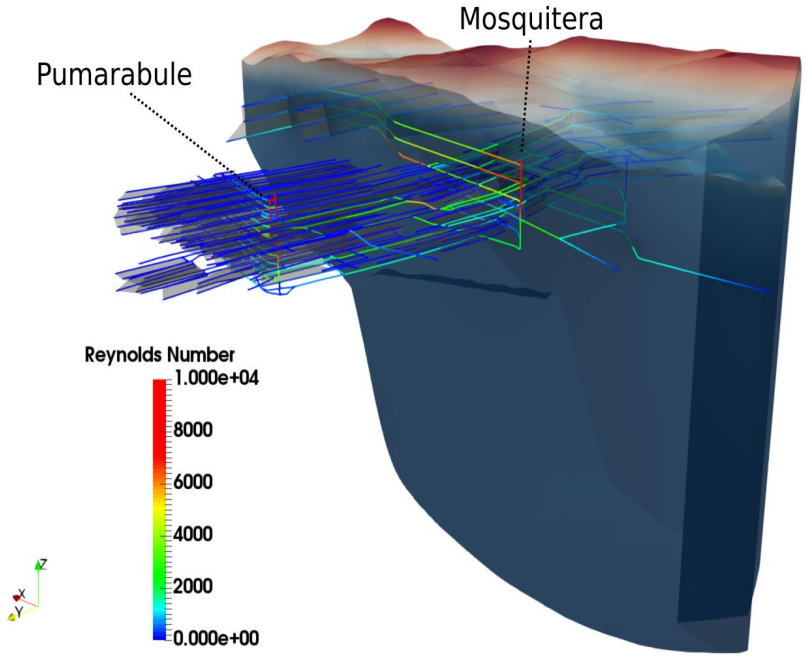
2 RESEARCH PAPERS

- *Riesgo, P., Rodríguez, G., Krzemień, A., García, S., Fidalgo, G. (2020). Subsidence versus natural landslides when dealing with property damage liabilities in underground coal mines.* ***International Journal of Rock Mechanics and Mining Sciences 126****, 104175.* *https://doi.org/10.1016/j.ijrmms.2019.104175*
- *Dudek, M., Tajduś, K., Misa, R., Sroka, A. (2020). Predicting of land surface uplift caused by fooding of underground coal mines – a case study.* ***International Journal of Rock Mechanics and Mining Sciences 132****, 104377.*

Main RESULTS (Models):

2. Suitable and validated models to proper describe groundwater flow and solute transport during the water rebound process, according to the specificity of the different sites.



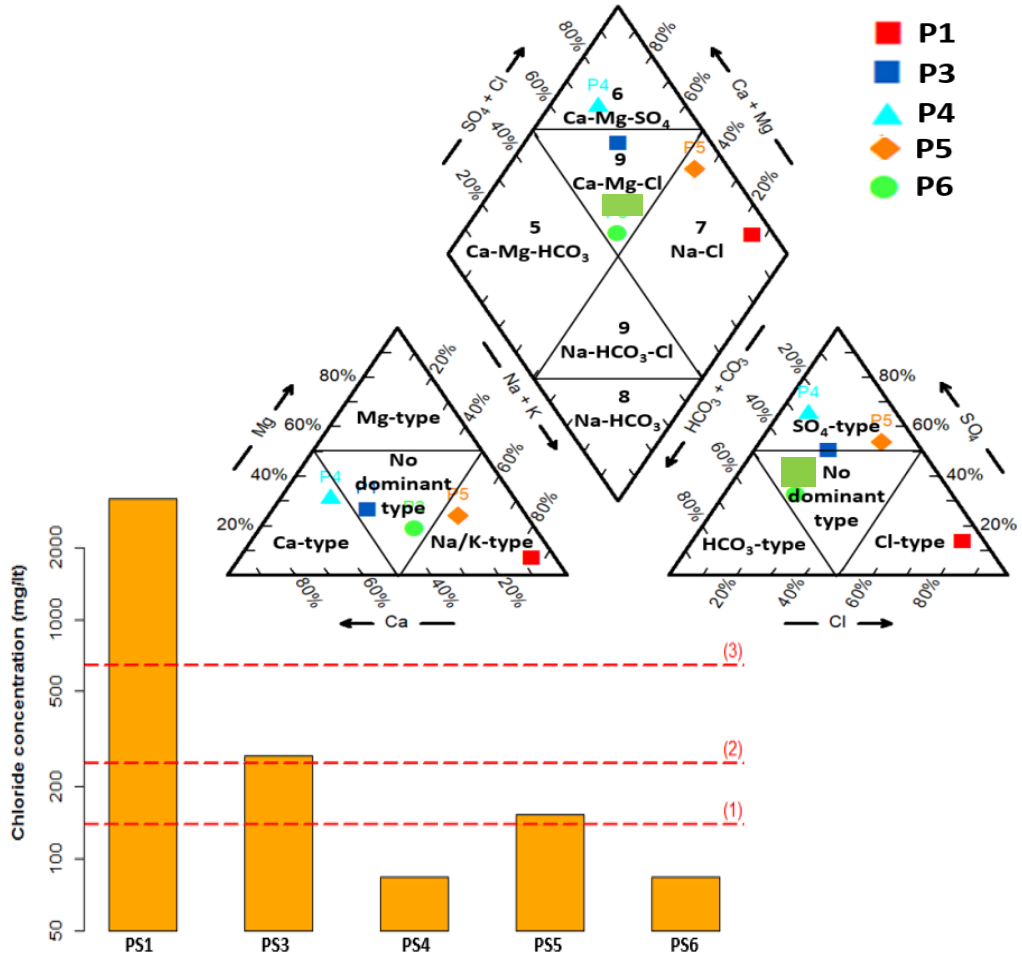


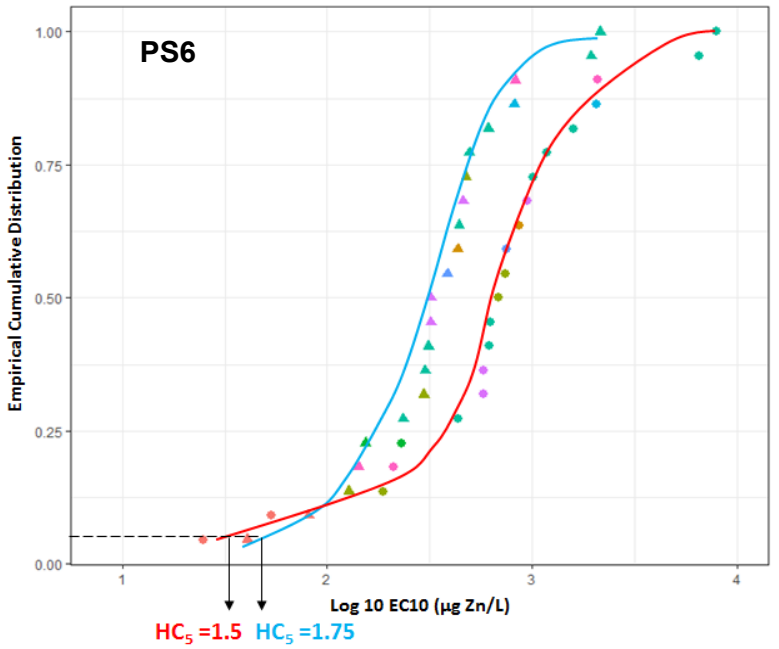
RESEARCH PAPER

- *González-Quirós, A., Fernández-Álvarez, J. P. (2019). Conceptualization and finite element groundwater flow modelling of a flooded underground mine reservoir in the Asturian Coal Basin, Spain.* ***Journal of Hydrology 578****, 124036.* *https://doi.org/10.1016/j.jhydrol.2019.124036*

Main RESULTS (Models):

3. Suitable and validated models to evaluate quantitatively the surface water environmental impacts during coal mine closure and post-closure periods.



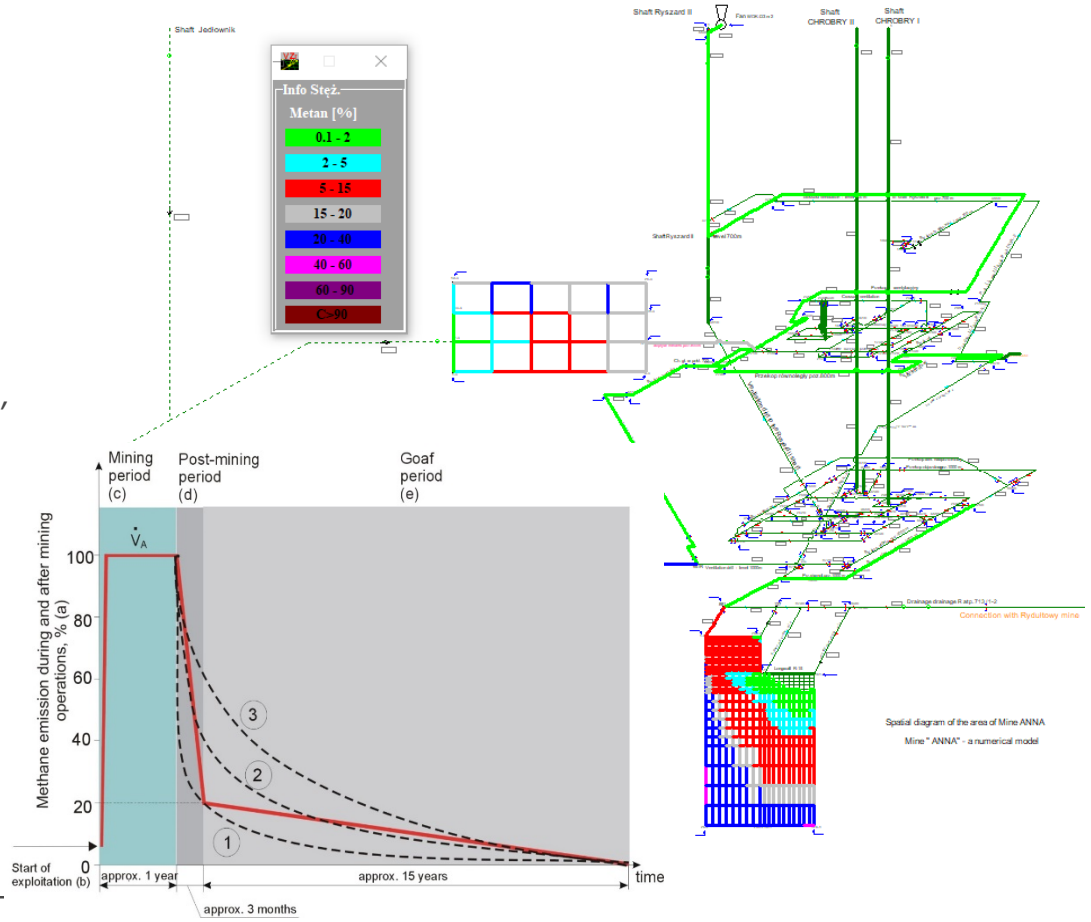


Main RESULTS (Models):

4. Suitable and validated models to assess the greenhouse gas emissions from closed mines with or without flooding to the surface.

3 RESEARCH PAPERS

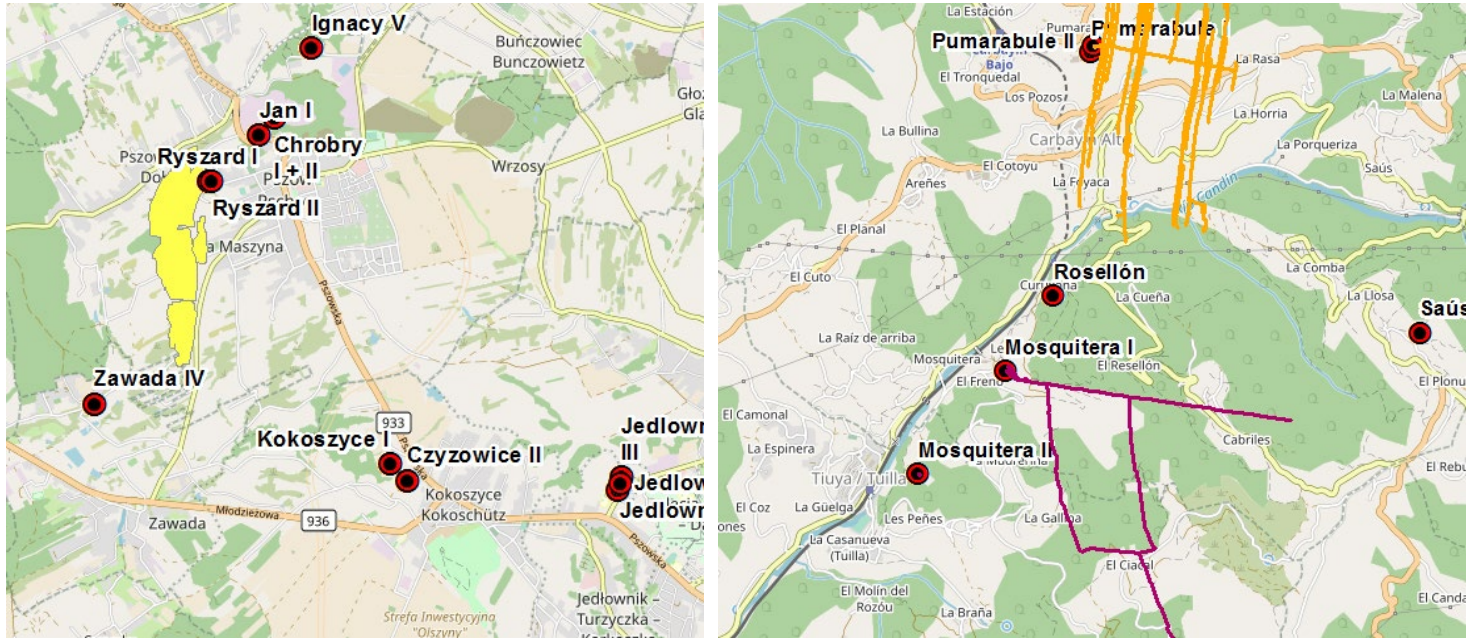
- *Skubacz, K., Wysocka, M., Michalik, B., Dziurzyński, W., Krach, A., Krawczyk, J., Pałka, T. (2019). Modelling of radon hazards in underground mine workings.* ***Science of The Total Environment 695****, 133853.* *https://doi.org/10.1016/j.scitotenv.2019.133853*
- *Wysocka, M., Skubacz, K., Chmielewska, I., Urban, P., Bonczyk, M. (2019). Radon migration in the area around the coal mine during closing process. International* ***Journal of Coal Geology 212****, 103253.* *https://doi.org/10.1016/j.coal.2019.103253*
- *Duda, A., Krzemień, A. (2018). Forecast of methane emission from closed underground coal mines exploited by longwall mining – A case study of Anna coal mine.* ***Journal of Sustainable Mining 17****(4), 184-194.* *https://doi.org/10.1016/j.jsm.2018.06.004*



Main RESULTS (ArcGIS database):

5. ArcGIS database with the modelling results integrated in the database and the web-based visualisation environment, allowing the joint interpretation of the different environmental impacts in relation to their spatial distribution and the sensitive receptors.

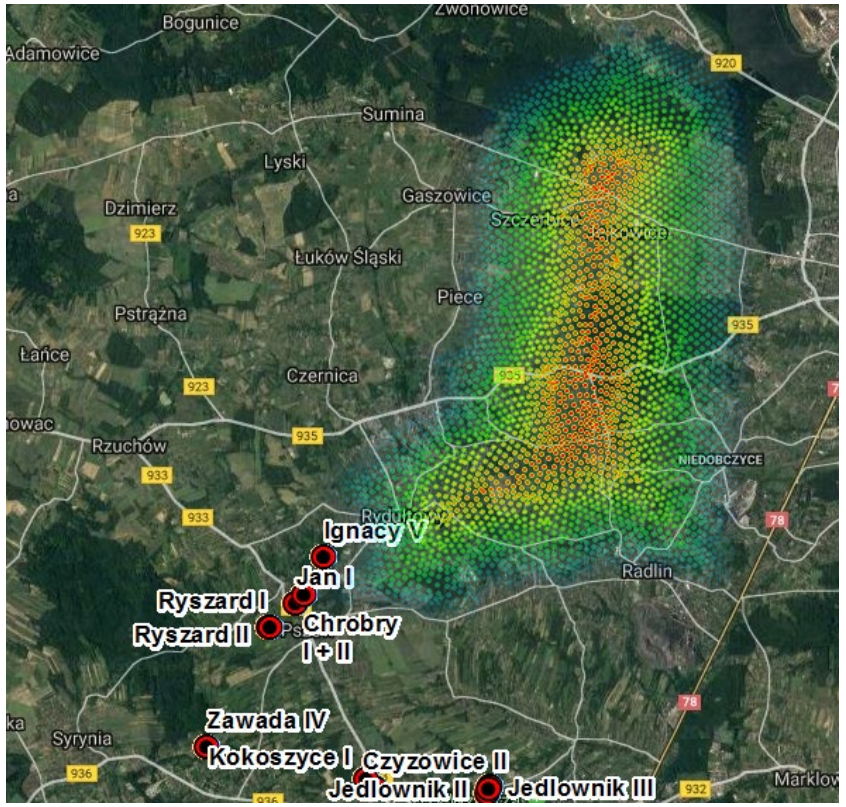
ArcGIS Database: https://safeguard.dmt.de/merida/?lang=en



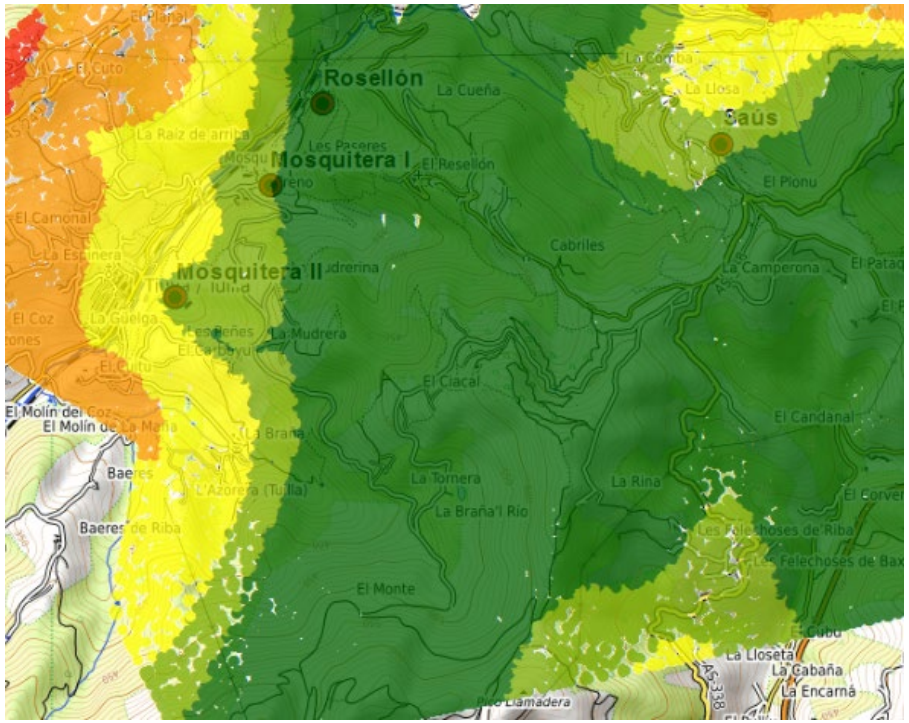
Polish (left) & Spanish (right) case studies with their shallow exploitations

ArcGIS Database

Contaminant plumes and hydraulic head



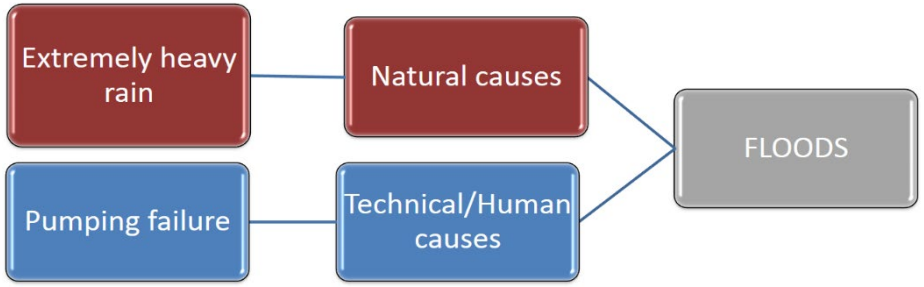
Poland: chloride plume year 50

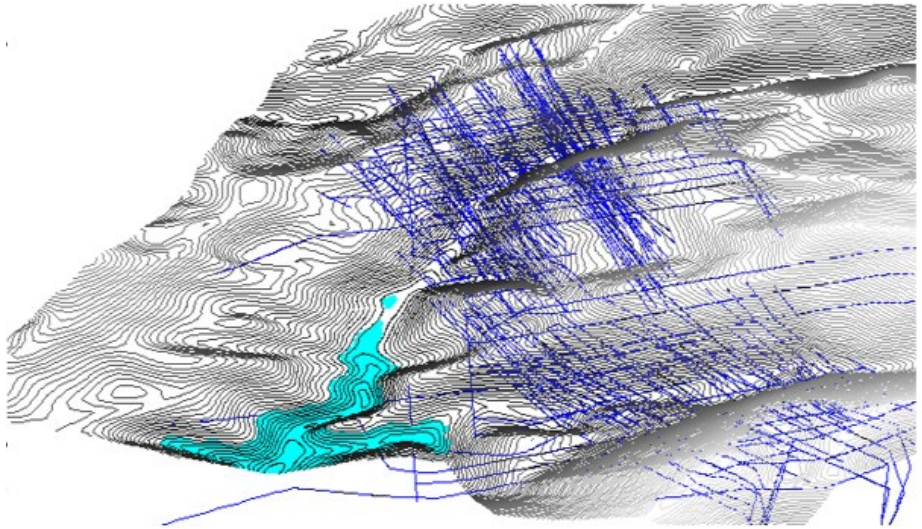


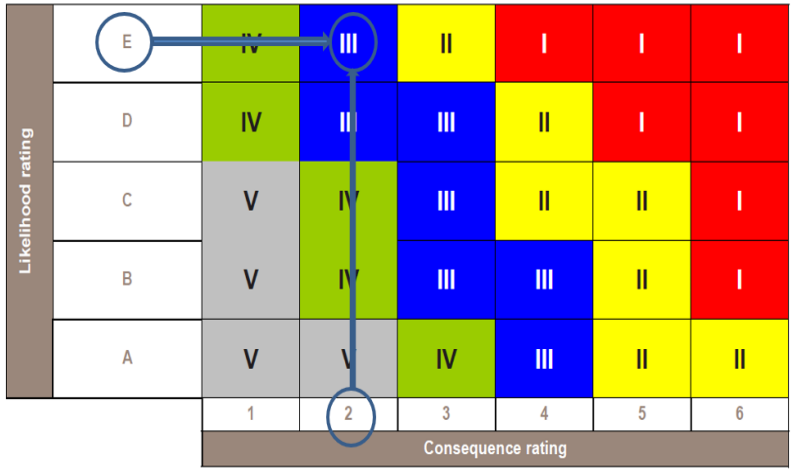
Spain: hydraulic head

Main RESULTS (Risk assessment):

Reports on the risk identification, risk analysis, risk evaluation and proposed treatment of areas exposed to ground movement risk, groundwater risk, surface water risk and gaseous emissions risk at the selected PGG and HUNOSA mines.







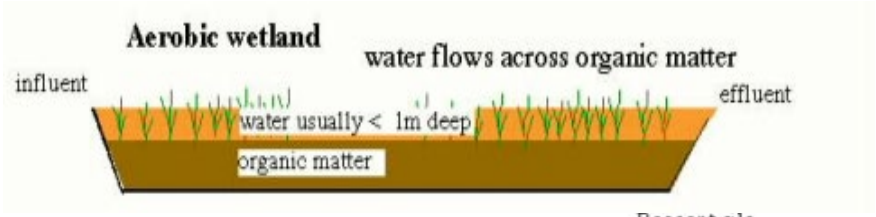
E ALMOST CERTAIN: Will occur or could occur within weeks or months

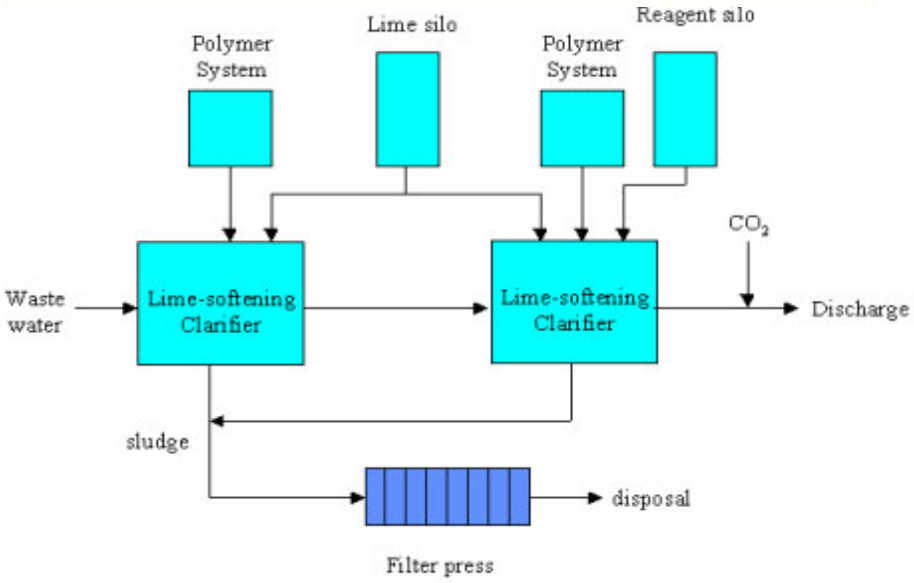
2 MINOR: Very low impact; loss between 10,000 € and 60,000 €

III MEDIUM: Specific measures should be adopted and implemented in a short period of time

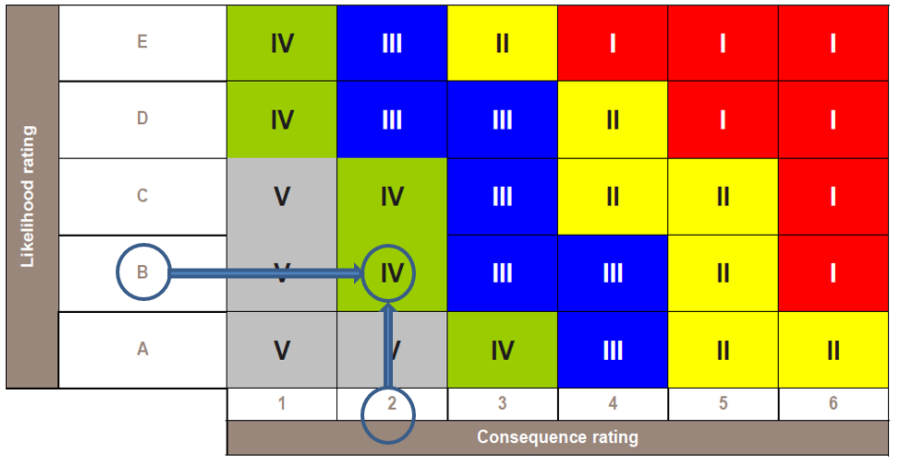
Main RESULTS (Forecasted environmental performance)

Reports on the forecasted environmental performance of the selected treatment options in terms of impacts and risks, at the selected PGG and HUNOSA mines.





Process: **Lime precipitation** **CESR process** **Recarbonation**



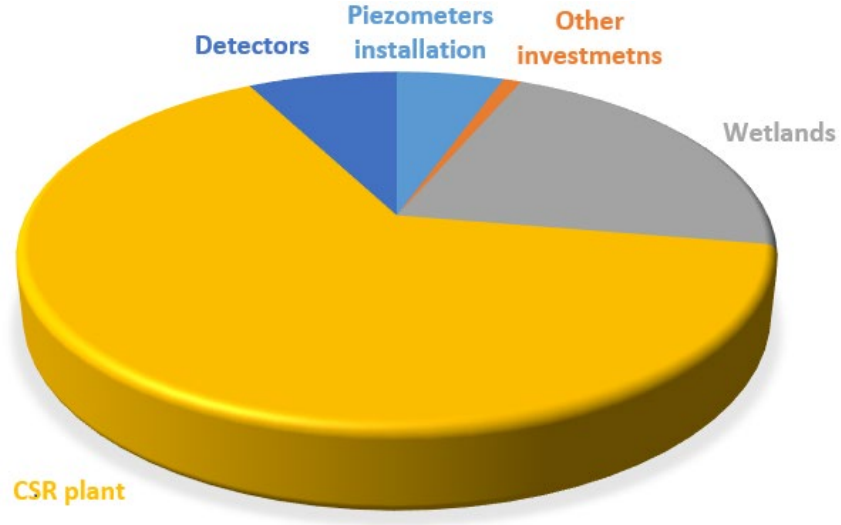
B UNLIKELY: Not likely to occur in normal circumstances

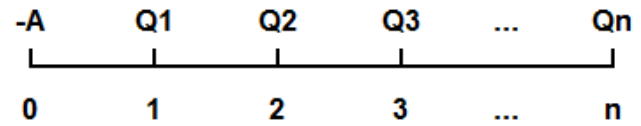
2 MINOR: Very low impact; loss between 10,000 € and 60,000 €

IV LOW: No need to change the controls, but not very expensive measures should be implemented. Periodic monitoring should be considered.

Main RESULTS (Cost analisis and financial provisions):

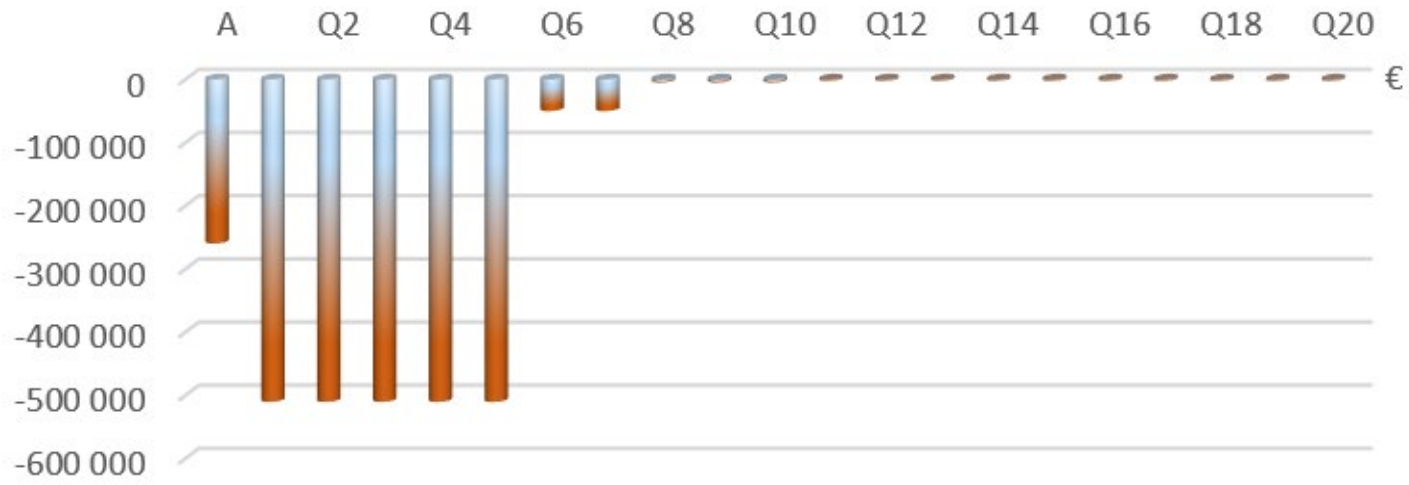
1. Reports on the cost analysis and financial provisions required for closure and post-closure for the selected PGG and HUNOSA mines.





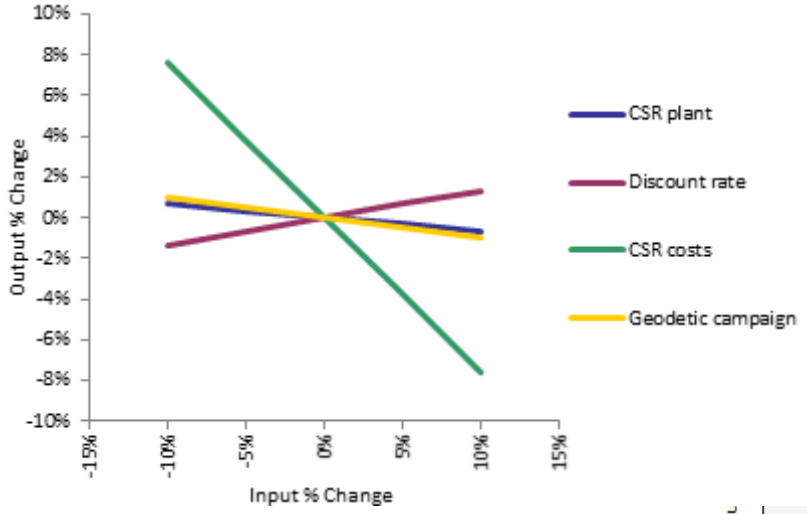
$$NPV = -A + \frac{Q_1}{(1+k)} + \frac{Q_2}{(1+k)^2} + ... + \frac{Q_n}{(1+k)^n}$$

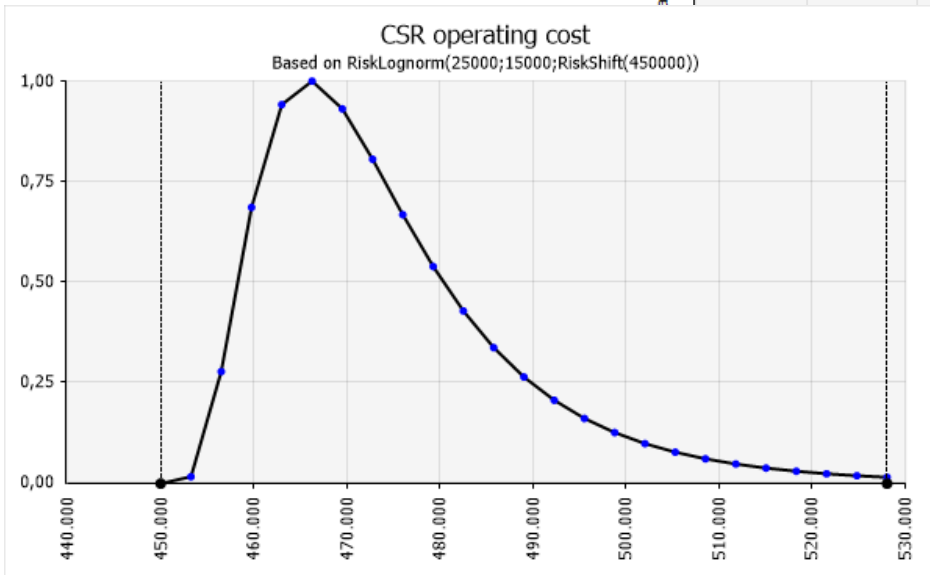
k = 5% ; n = 20

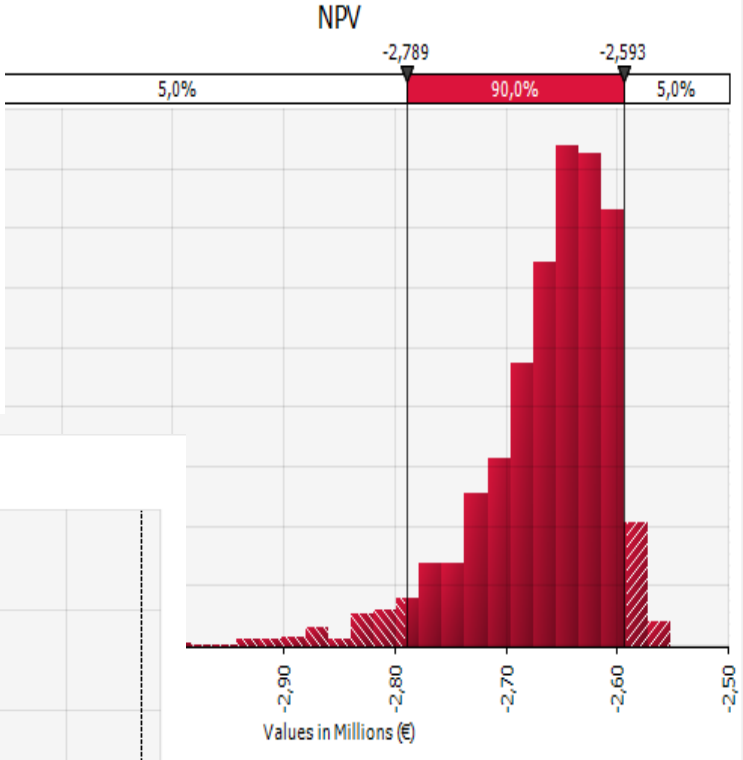


Main RESULTS (Cost analisis and financial provisions):

2. Sensitivity and uncertainty analysis of the financial provisions.







	NPV
Cell	NPV!C1
Minimum	-€3.147.186,10
Maximum	-€2.552.024,28
Mean	-€2.664.337,25
90% CI	± €3.373,14
Mode	-€2.665.460,49
Median	-€2.649.095,70
Std Dev	€64.789,47
Skewness	-1,8695
Kurtosis	9,3046
Values	1000
Errors	0
Filtered	0
Left X	-€2.788.927,88
Left P	5,0%
Right X	-€2.593.177,30
Right P	95,0%
Dif. X	€195.750,57
Dif. P	90,0%
1%	-€2.892.678,44

Main RESULTS (Best practice guideline)

Best practice guideline for the prediction environmental impacts and the management of risk during coal mine closure and post-closure:

https://www.gig.eu/en/international-projects/merida

MERIDA. Rydułtowy - Anna Mining Complex	Model
	Risk assessment
	Risk identification
	Risk analysis
Ground movement	Risk evaluation
Groundwater	Proposed treatments
Surface water	Performance forecast
Gas	Economic evaluation

MERIDA. Mosquitera and Pumarabule Mines	Model
	Risk assessment
Ground movement	Economic evaluation
Groundwater	Cost evaluation
Surface water	Financial provision
Gas	Uncertainty analysis

RESEARCH PAPER

- *Krzemień, A.; Suárez Sánchez, A.; Riesgo Fernández, P.; Zimmermann K. & González Coto, F. (2016). Towards sustainability in underground coal mines closure contexts: A methodology proposal for environmental risk management.* ***Journal of Cleaner Production 139****, 1044-1056.* *https://doi.org/10.1016/j.jclepro.2016.08.149*

CONCLUSIONS:

- The first step of MERIDA project was to establish the framework for the compilation of relevant data related to environmental impacts during the coal mine closure and post-closure stages.
- In second place, risk criteria was established for each impact category considered, in order to set the acceptable thresholds against which risk evaluation will be carried out.
- From this starting point, site specific issue-based models were developed and validated, and the results were integrated in a database and web-based visualization environment, allowing the joint interpretation of results.
- After, results were used to perform a risk evaluation in order to compare the estimated levels of risk with the risk criteria previously defined, and to decide which risks need treatment. Possible risk treatment strategies were identified and evaluated in terms of performance and costs.
- Taking all the costs into account, Net Present Values were calculated in order to determine the financial provisions required for closure and post-closure stages. Then, sensitive analysis of the calculations were developed, followed by uncertainty analysis, and finally providing a financial provision for each company.

Thank you very much for your attention

Grant Agreement No. RFCR-CT-2015-00004
15/12/2015 - 15/12/2019

Pedro Riesgo
University of Oviedo
Spain

RECOVERY project

Alicja Krzemień

Central Mining Institute

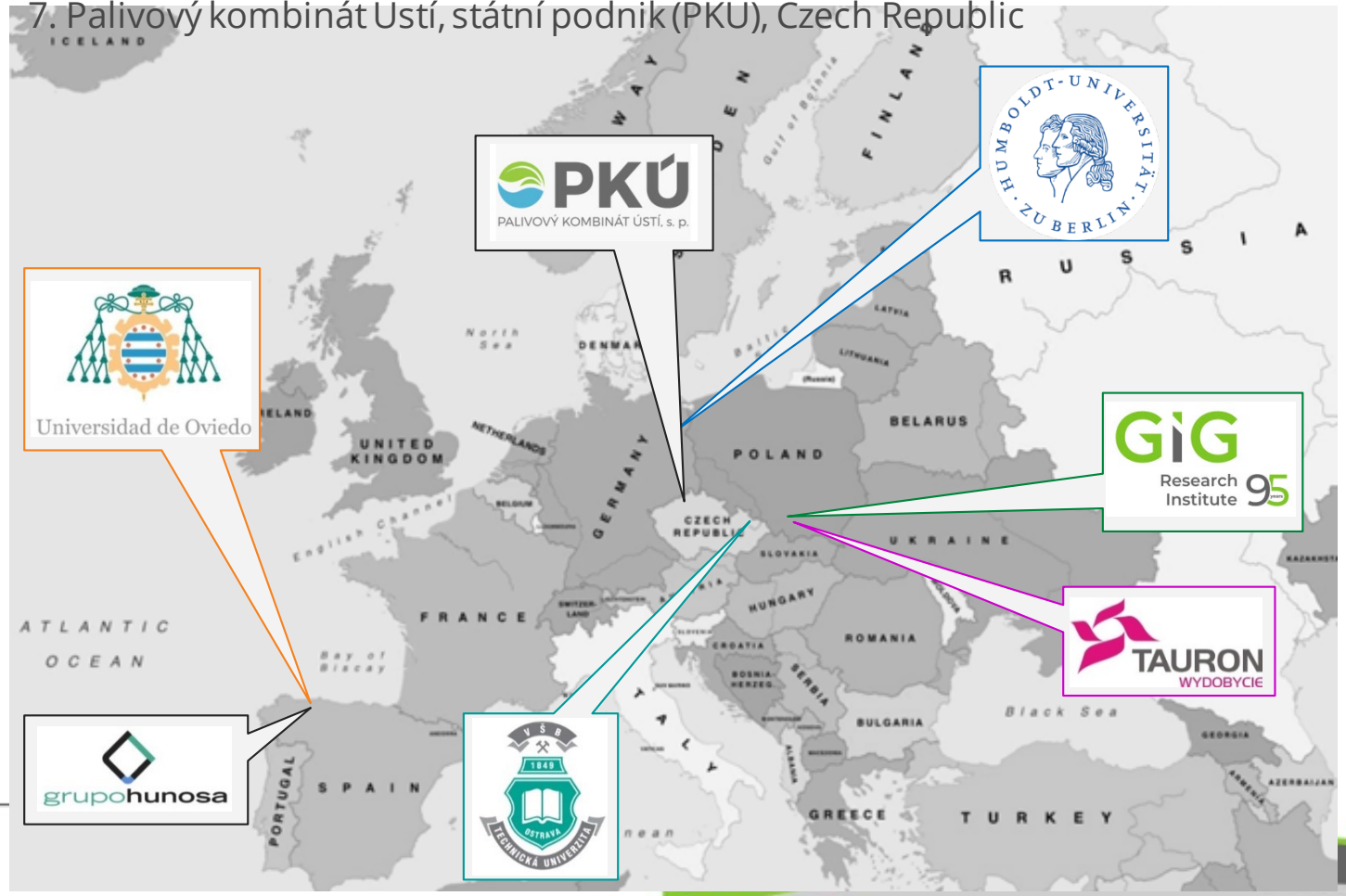
Recovery of degraded and transformed ecosystems in coal mining-affected areas

Grant Agreement No. 847205-RECOVERY-RFCS-2018
07/2019 - 06/2023

Alicja Krzemień

RECOVERY - INDIVIDUAL PARTNERS OF THE CONSORTIUM

1. Główny Instytut Górnictwa (Central Mining Institute) (GIG), Poland - coordinator
2. Universidad de Oviedo (UNIOVI), Spain
3. Humboldt Universität zu Berlin (UBER), Germany
4. Vysoka Skola Banska-Technicka Univerzita Ostrava (VSB), Czech Republic
5. Hulleras Del Norte SA (HUNOSA), Spain
6. Tauron Wydobycie SA (TWD), Poland
7. Palivový kombinát Ústí, státní podnik (PKÚ), Czech Republic

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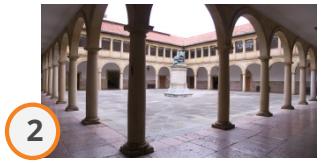
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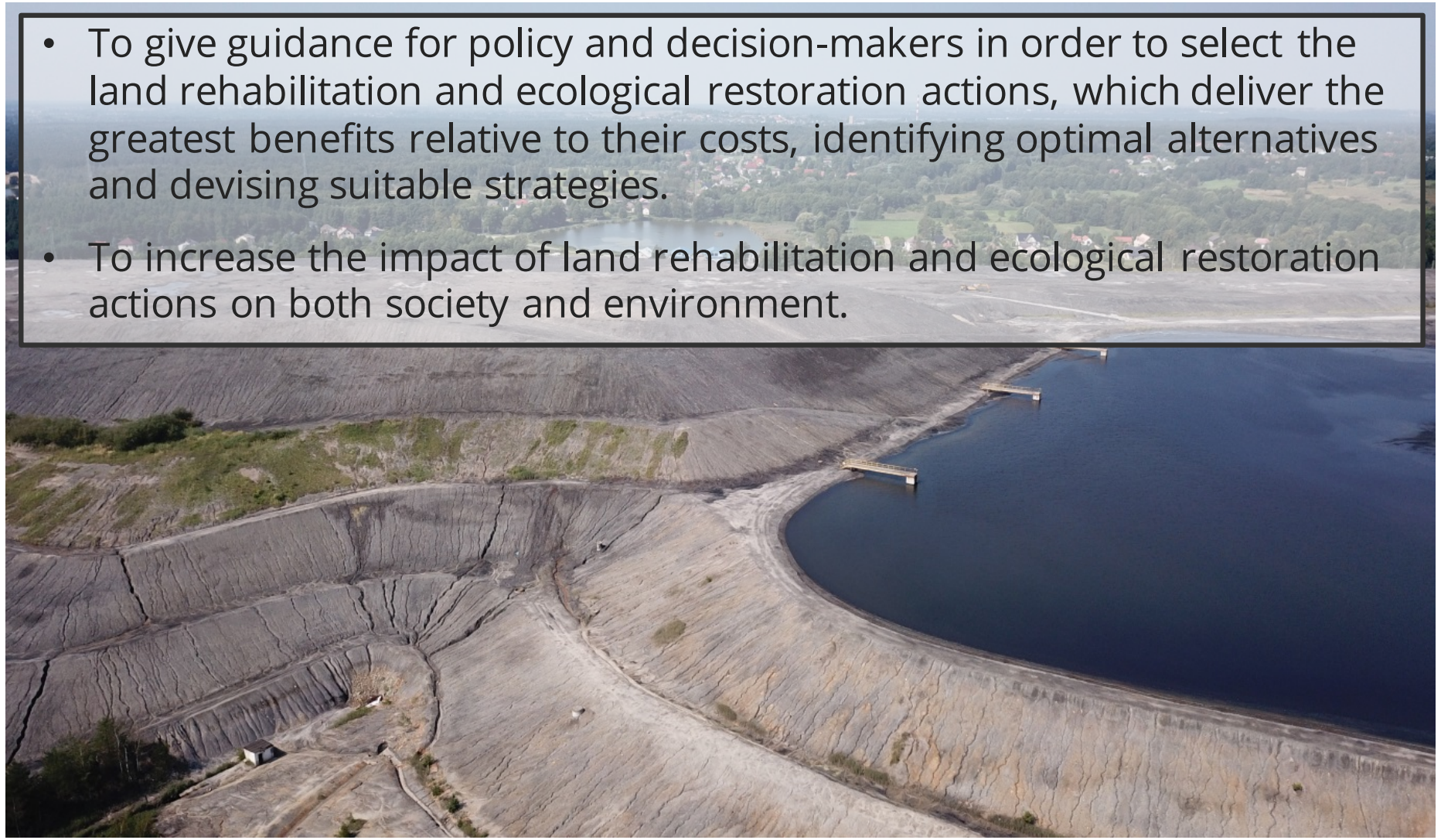
7

Instytut Badawczy 95 lat

OBJECTIVES

- To give guidance for policy and decision-makers in order to select the land rehabilitation and ecological restoration actions, which deliver the greatest benefits relative to their costs, identifying optimal alternatives and devising suitable strategies.
- To increase the impact of land rehabilitation and ecological restoration actions on both society and environment.



OBJECTIVES

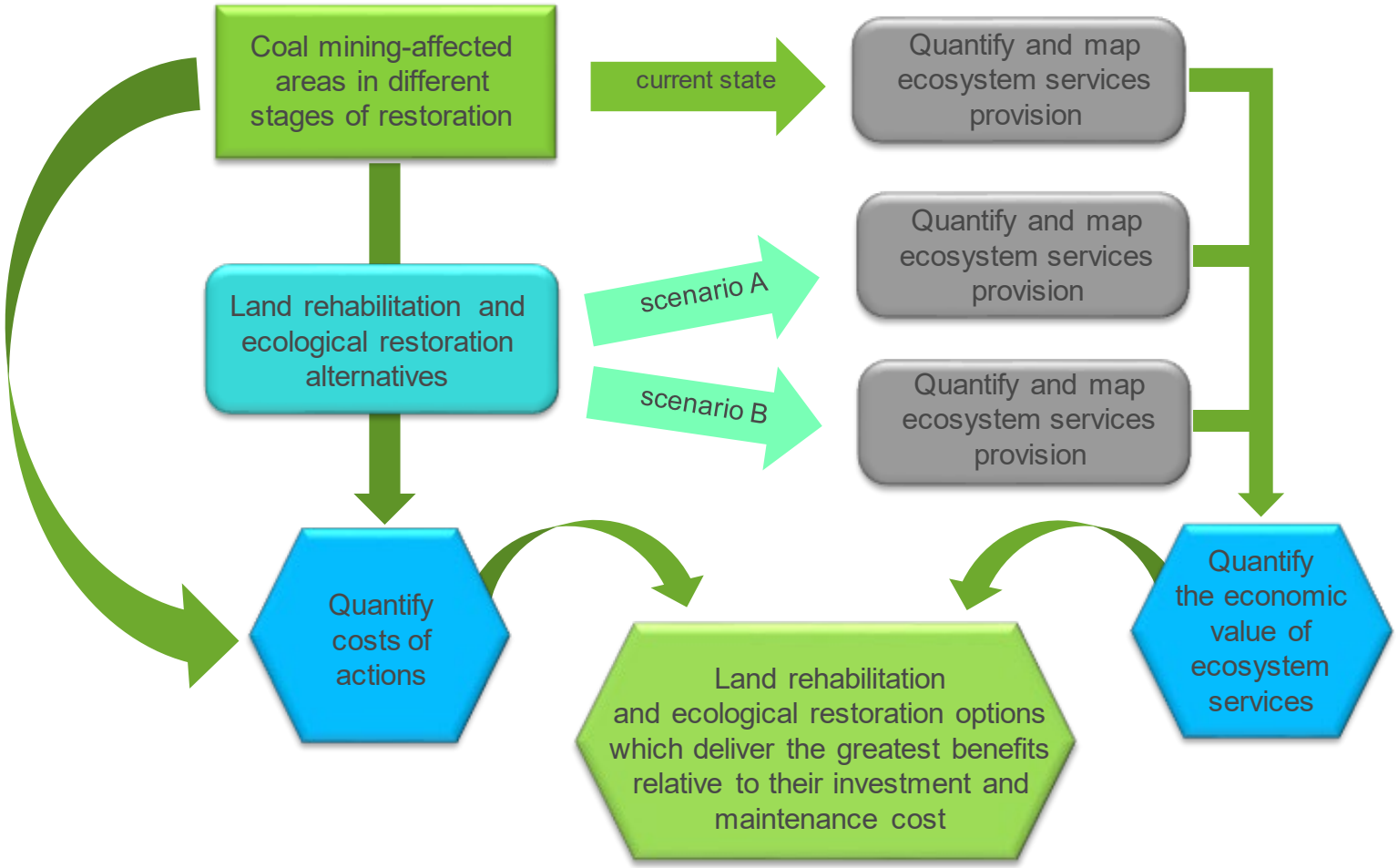
- To deliver, addressing specifically coal mining-affected areas: (a) detailed costs of land rehabilitation and benefits in the provision of ecosystem services; (b) suitable indicators for these ecosystem services; (c) feasible valuation techniques and optimal discount rates.
- To deliver and innovative framework for land rehabilitation and ecological restoration of coal mining-affected areas, conceived as “Best practice guidelines”.

How to tackle the environmental and social costs and benefits of restoration?

A valuation of the ecosystem services provided by different land rehabilitation and ecological restoration scenarios must be undertaken in order to:

- ❑ **assess their contribution to human well-being,**
- ❑ **understand the incentives that individual decision-makers face in managing ecosystems in different ways,**
- ❑ **evaluate the consequences of alternative courses of action.**

PROJECT'S METHODOLOGY



OUTCOME

RECOVERY will demonstrate approaches and best practices for analyzing land rehabilitation and ecological restoration actions.
RECOVERY will assess the contribution of selected ecosystems to human wellbeing by means of the innovative 'ecosystem-services' concept, evaluating the consequences of alternative courses of action so that their capacity to provide benefits to society will not be diminished but, if possible, improved.

- The first comprehensive attempt at an European/worldwide scale to link the fields of land rehabilitation and ecological restoration with the ecosystem services concept in underground and opencast coal mining-affected areas.

Artificial substitutes for soils in difficult terrains

Environmental impact of Janina Waste Heap include:

- Air quality deteriation–spreading of suspended dust during dry and wind periods.
- Biodiversity loss - acid properity of gangue is inconvenient as habitat for plant and animal = lost of areas with regulation (i.e. local climat regulation, and cultural function (interactions with living system).
- Surface and groundwater pollution – acid rock drainage is observed in the water runoff process during precipitation.
- The wastes stored on the heap cover an area of 80 hectares, reaching the height of 35 metres

Artificial substitutes for soils in difficult terrains

TESTED WASTE MATERIALS

Coal combustion by-products +

- **Fly ashes and slags** *Power plant Jaworzno 3*
- **Energetic slags** *Power plant Łaziska*
- **Biomass combustion ashes** *Power plant Jaworzno 3*

Sludges +

- **Sealing material** *Sobieski coal mine*
- **Decarbonisation lime** *Power plant Łaziska*

Agregate +

- **Mine wastes** (0-2 mm) *Sobieski coal mine*

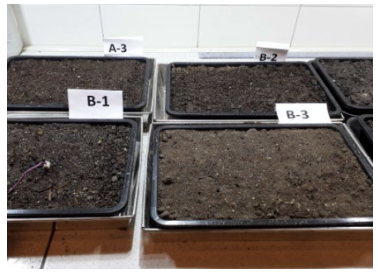
Organic matter

- **Sewage sludge** *Waste water treatment plant*
- **Spent mushroom compost** *agricultural sector*

ROCK WASTE

waste heap in JANINA coal mine

Artificial soil substitutes



Phytotests with **white mustard**

Recovery
RFCS RESEARCH PROJECT

GIG Instytut Badawczy 95 lat

THANK YOU FOR YOUR ATTENTION!

WWW.RECOVERYPROJECT.EU

Grant Agreement No. 847205-RECOVERY-RFCS-2018
07/2019 - 06/2023

Alicja Krzemień

LIFE BRINE-MINING project

Dimitris Xevgenos

LIFE BRINE-MINING project

SEALEAU
next generation desalination.
circular.

Coal mines are closing but the wastewater problem remains

Dr. Dimitris Xevgenos
Innovation Manager,
LIFE BRINE-MINING project

Contributions from : Central Mining Institute

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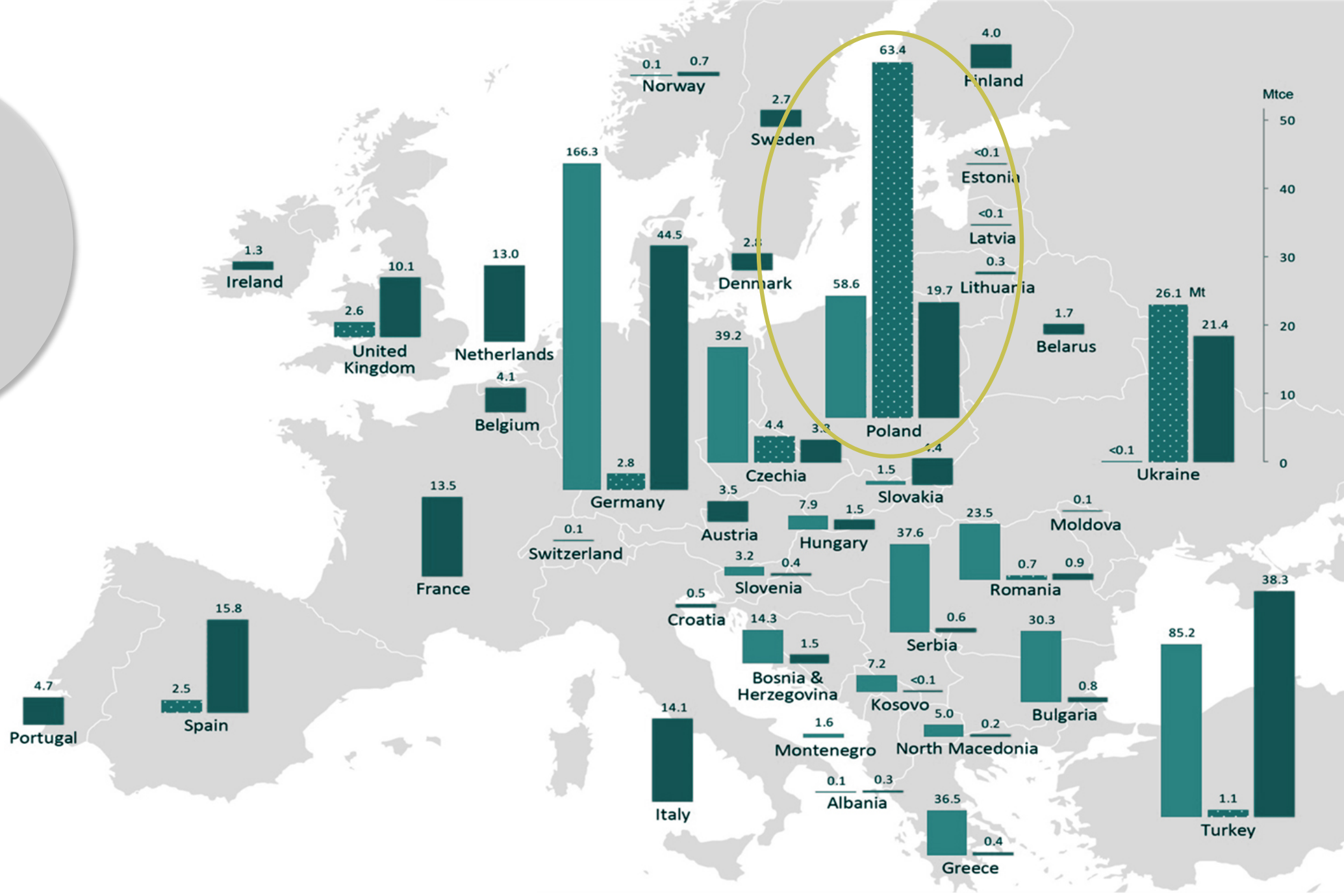
1. Coal mines in Europe
2. Coal mine closure & wastewater
3. LIFE BRINE-MINING & Circular Economy

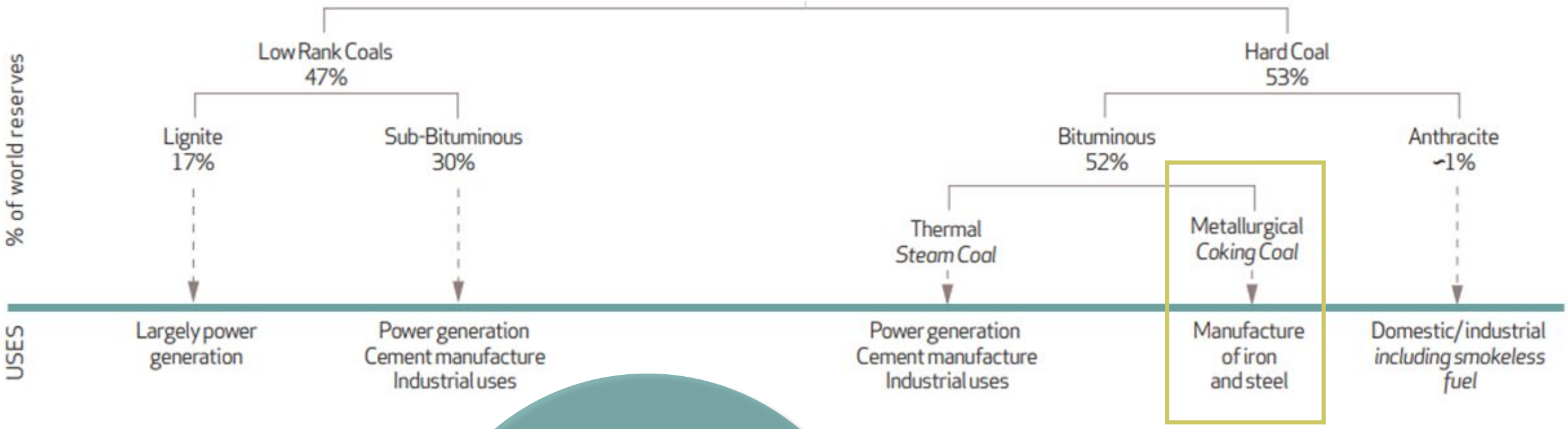
83%

Poland



EU - 28 million tonnes

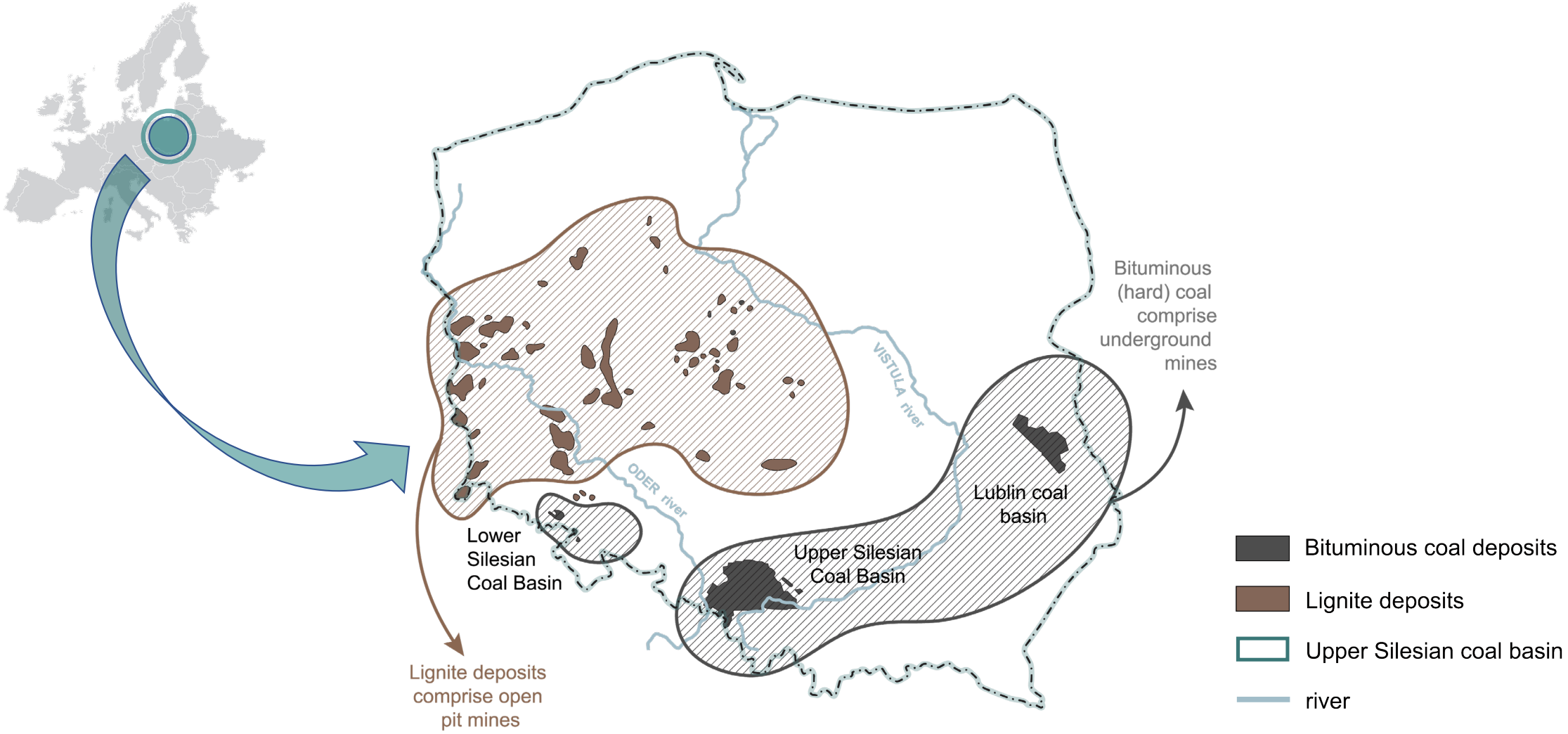
lignite	367
hard coal	76
imports	167



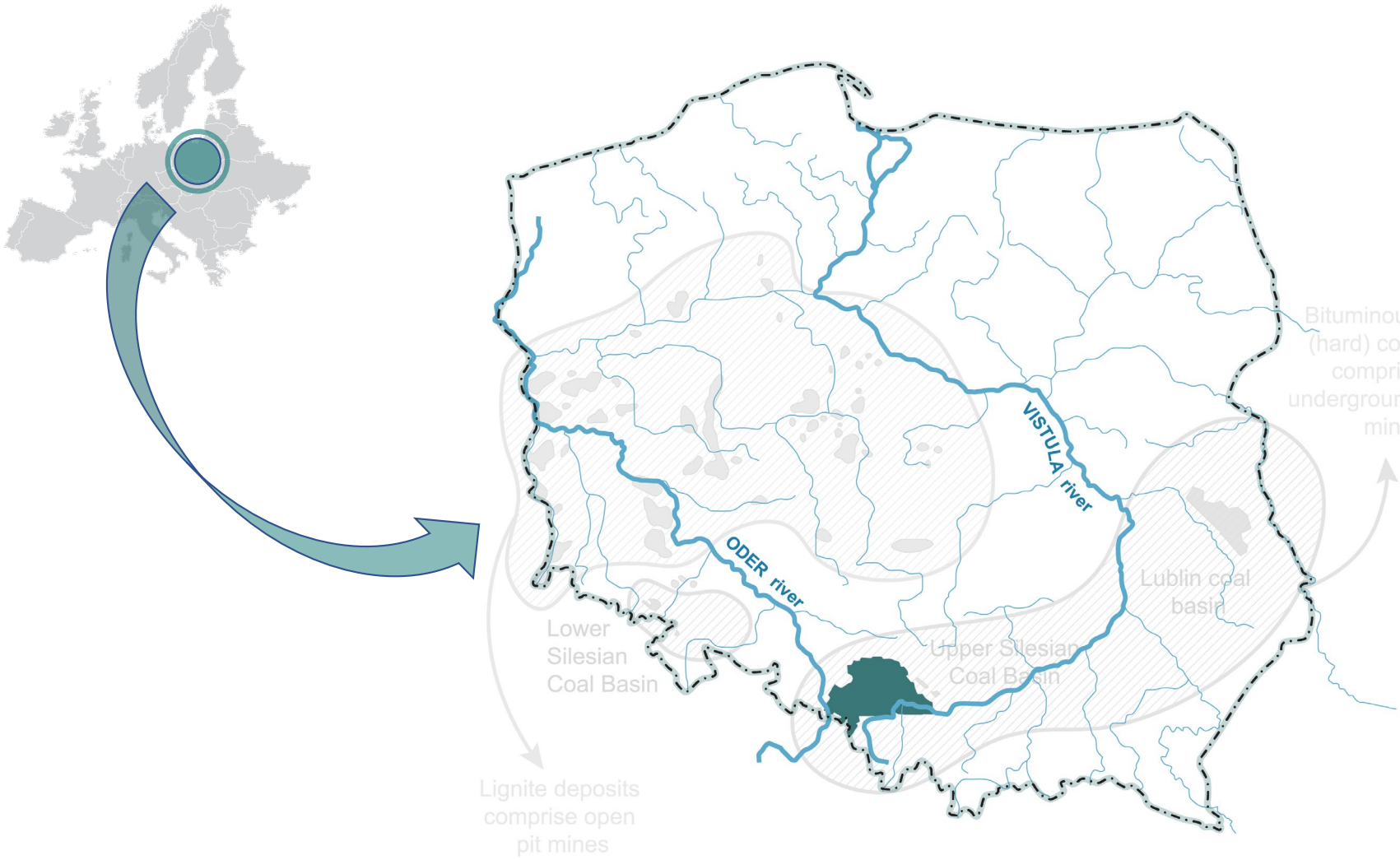
Coking coal : **1 out of 30 critical raw materials** identified by EC

almost 70% of the steel produced today relies directly on metallurgical coal

Coal mines in Poland



Coal mines in Poland



Source: Statistical analyses. Environment 2019, Statistics Poland, Spatial and Environmental Surveys Department, November 2019, Warsaw

Oder (Odra) river

Vistula (Wisłą) river

Source : Jasinski, P., & Lawton-Smith, H. (2018). *Environmental regulation in transforming economies: the case of Poland.* Routledge.

Silesia region (Slaskie)

1. KWK Borynia-Zofiówka
2. KWK Budryk
3. KWK Knurów Szczygłowice
4. KWK Pniówek
5. KWK Jaworzno-Bzie
6. KWK ROW
7. KWK Ruda
8. KWK Piast-Ziemowit
9. KWK Sośnica
10. KWK Bolesław Śmiały
11. KWK Wujek
12. KWK Myslowice-Wesola
13. KWK Murcki-Staszic
14. ZG Brzeszcze
15. ZG Janina
16. ZG Sobieski
17. KWK Silesia
18. KWK Bodganka

active mines

abandoned, dewatered mines

* small private mines

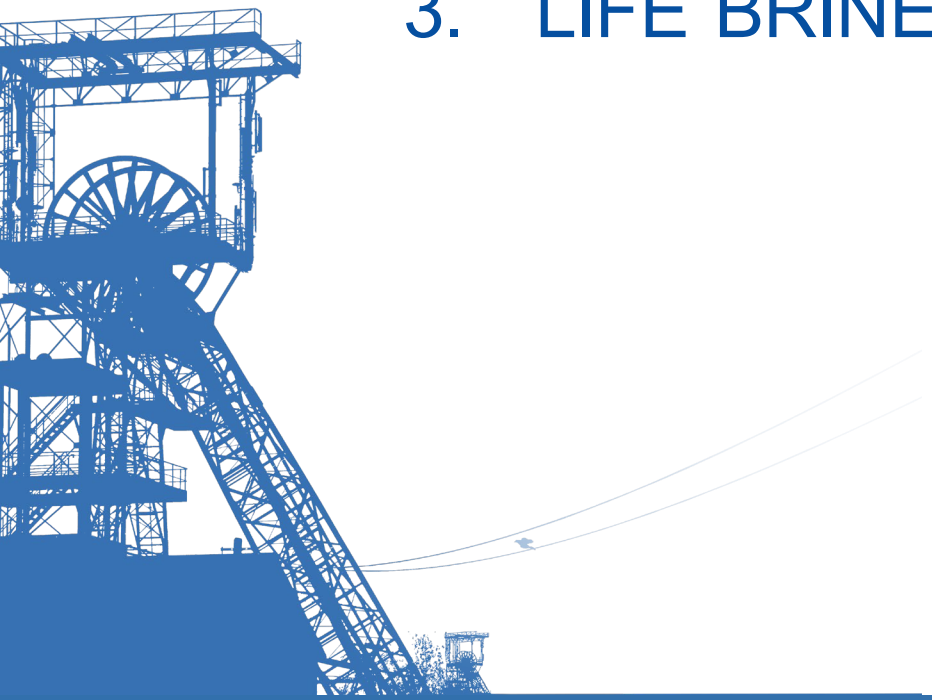
upper Silesian coal basin boundary

Dębieńsko case study

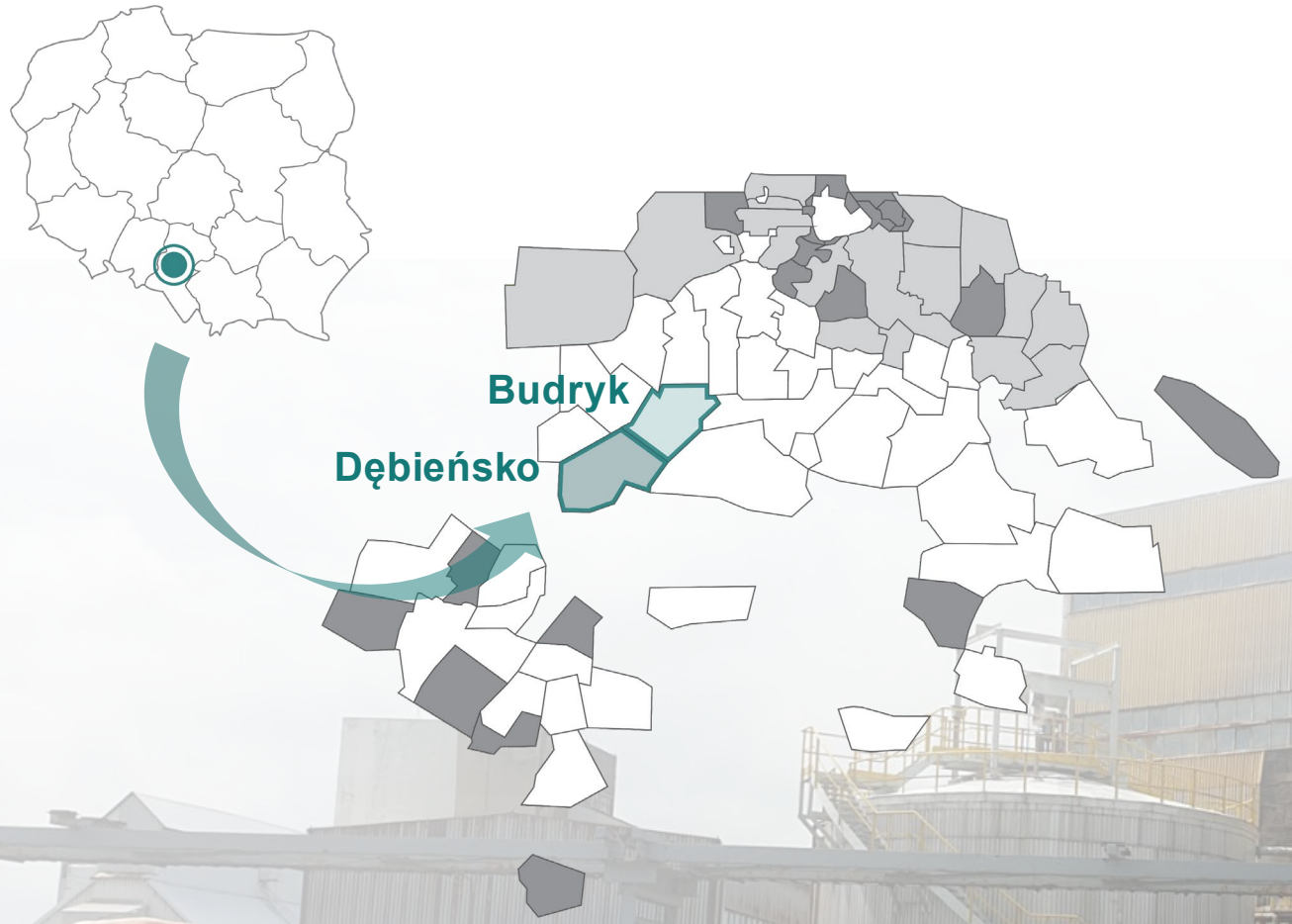
rivers

hydrogeological subregion boundary

Index

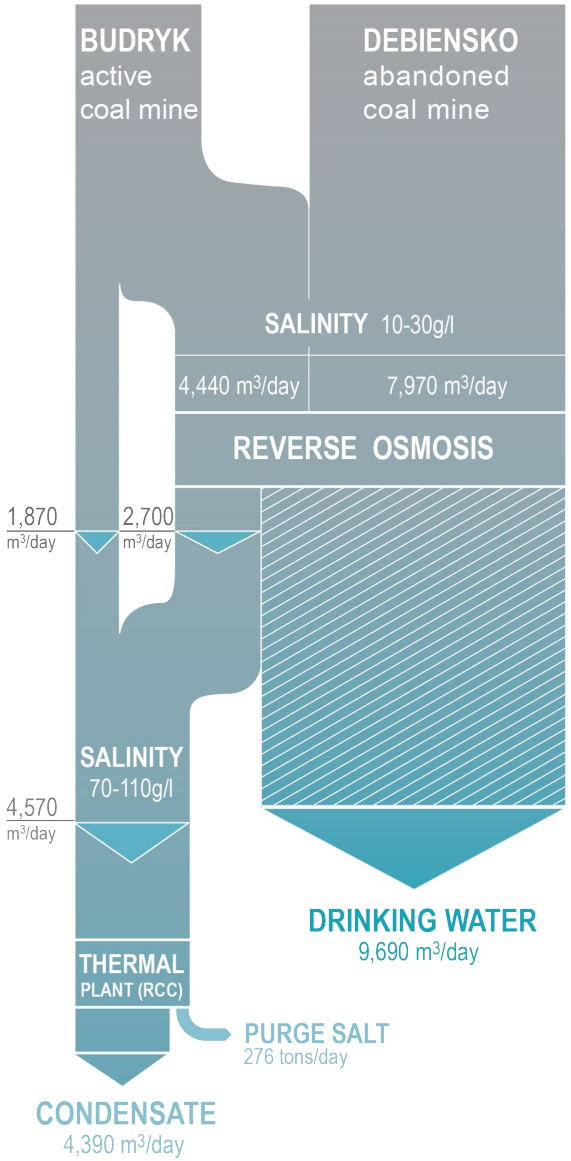


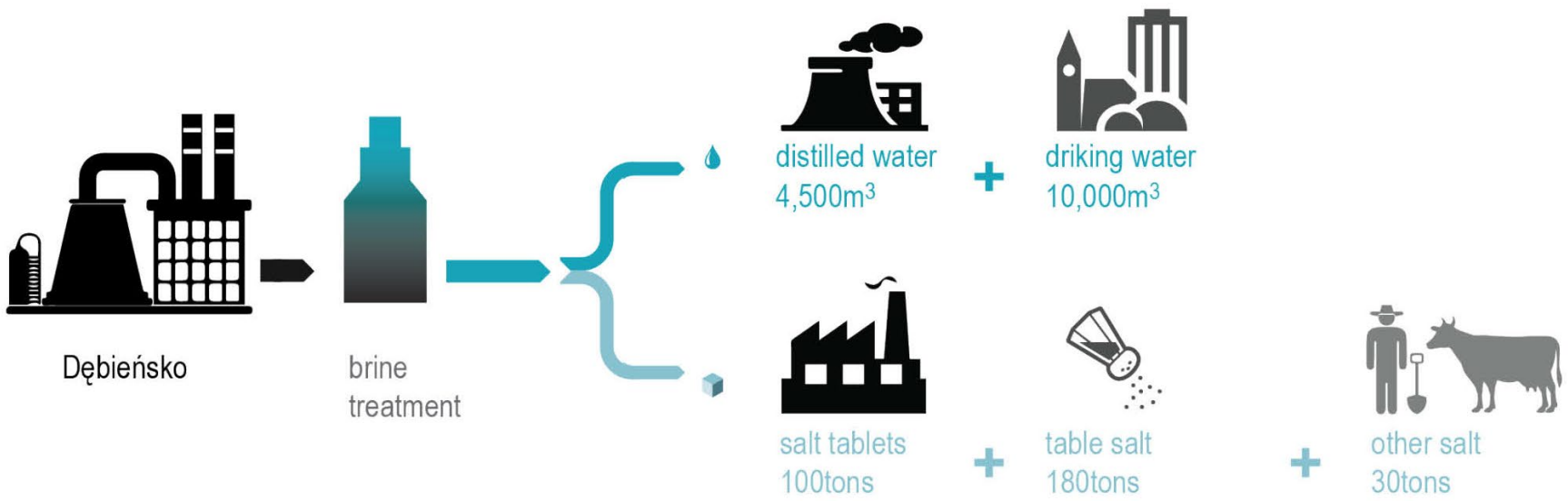
Dębieńsko Coal Mines



1st plant globally to apply Zero Liquid Discharge system to treat coal mine brine

Dębieńsko Coal Mines





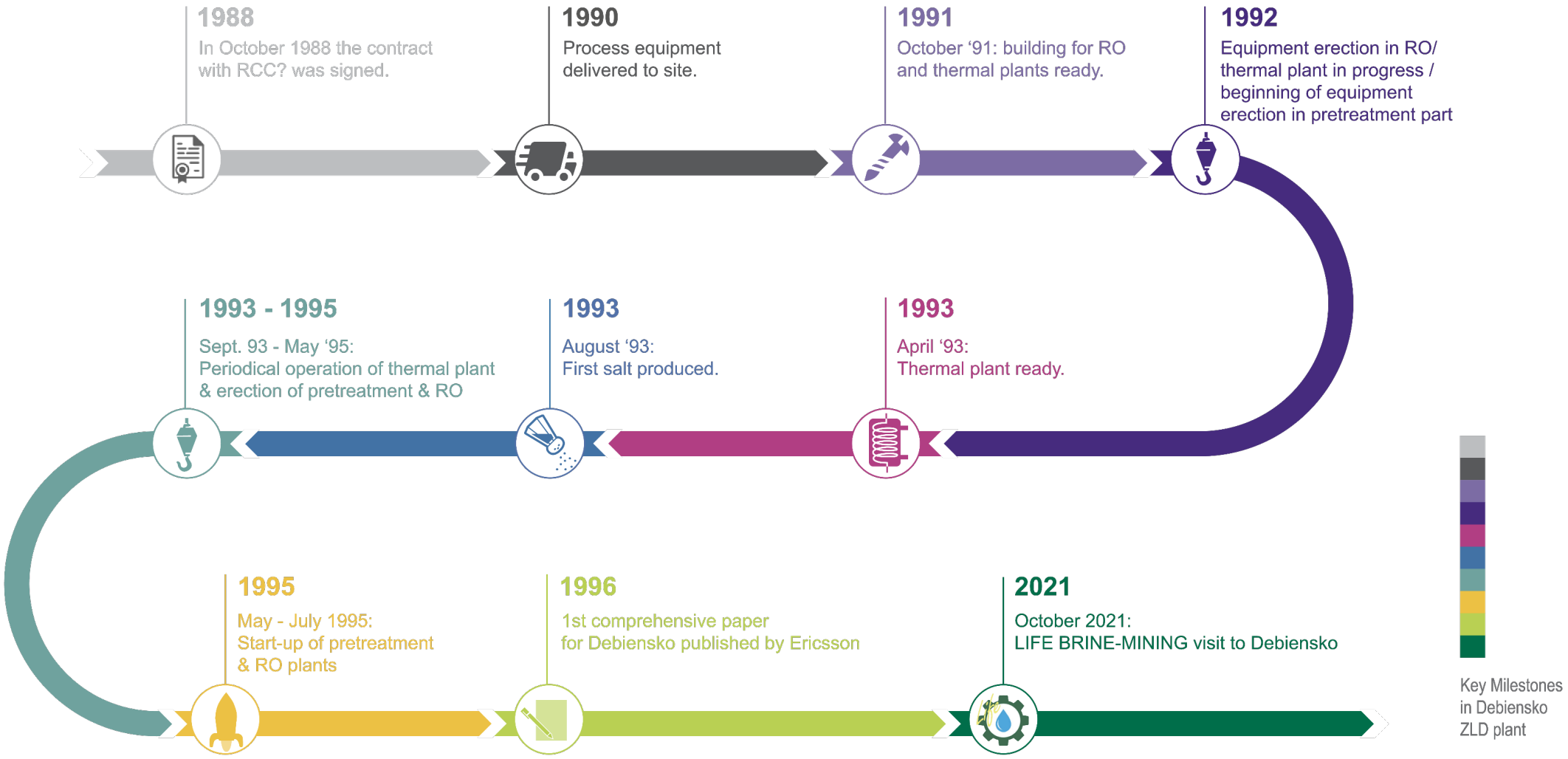
- Treat coal mine brine effluent
- Recover water & saleable salts

US $ 60 million for the equipment

Main drawback:

extremely high energy consumption (~970 kWh/t of salt recovered)

Dębieńsko Coal Mines: Storyline



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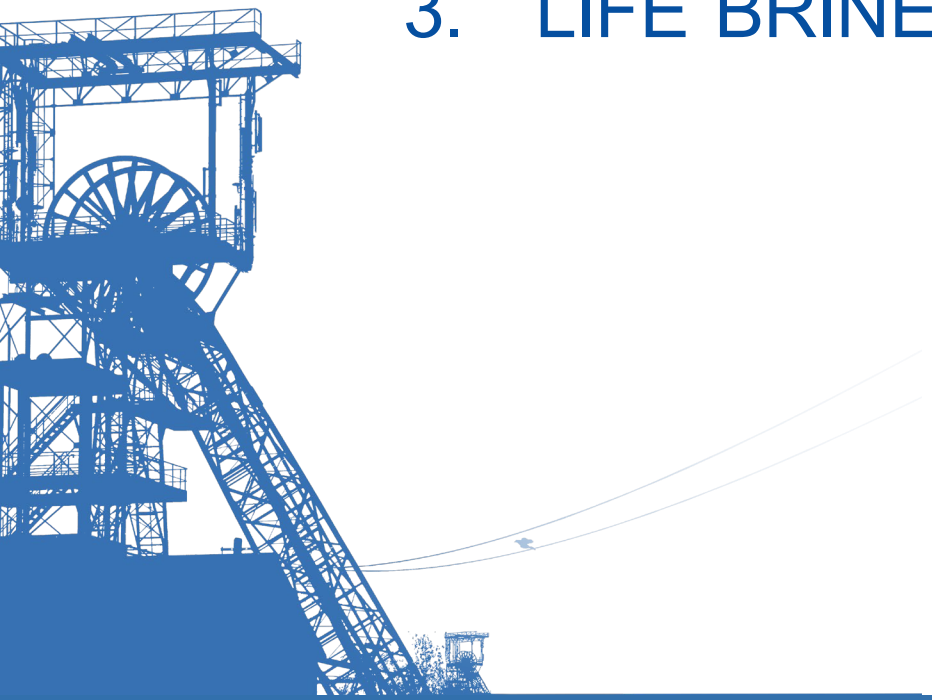


LIFE BRINE-MINING project

LIFE18 ENV/GR/000019

Budget

Total budget	6,383,847 €
EU contribution	3,508,365 €

Dates

Start	01/09/2019
End	03/09/2023
Duration	48 months

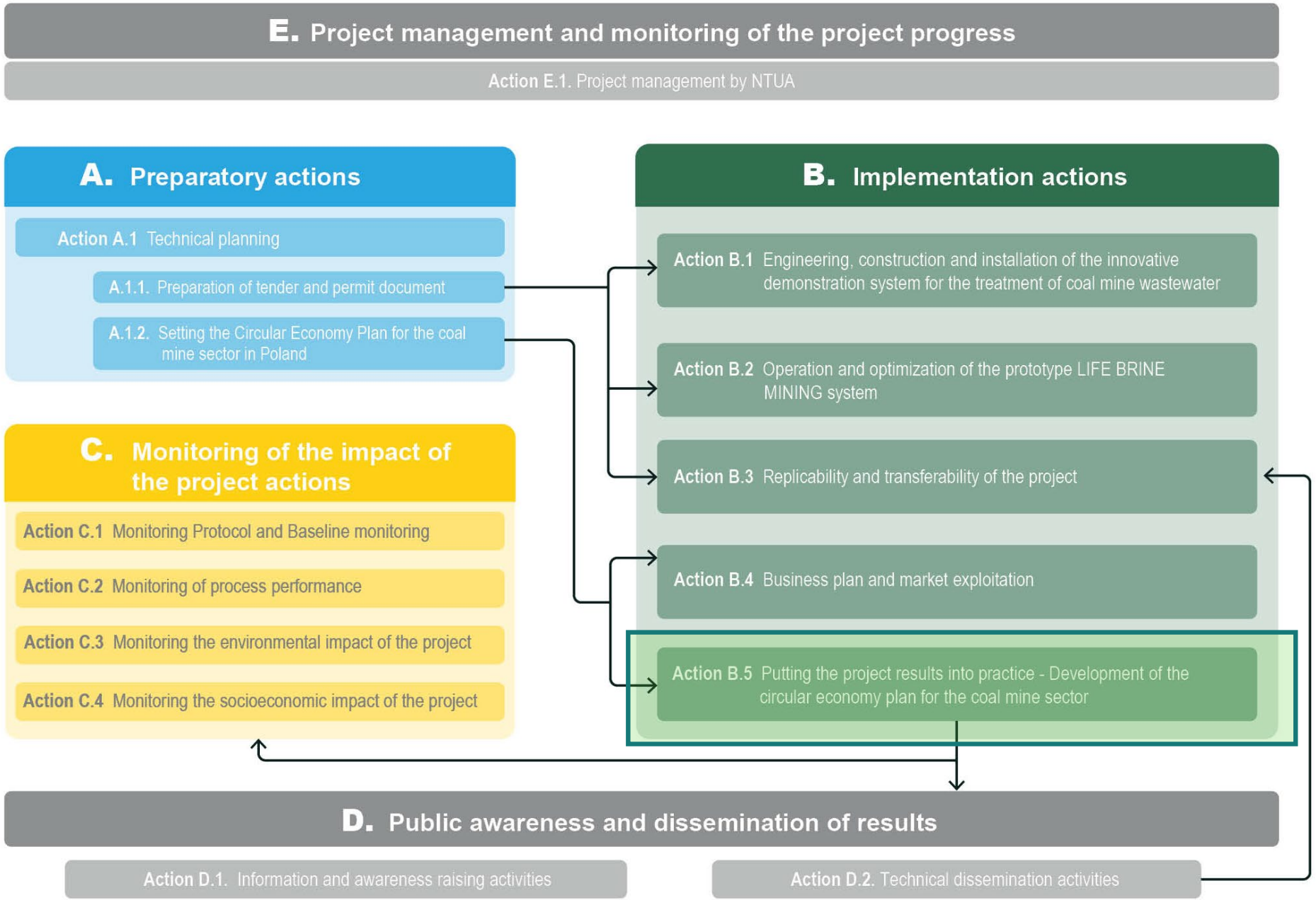
Solon Mias

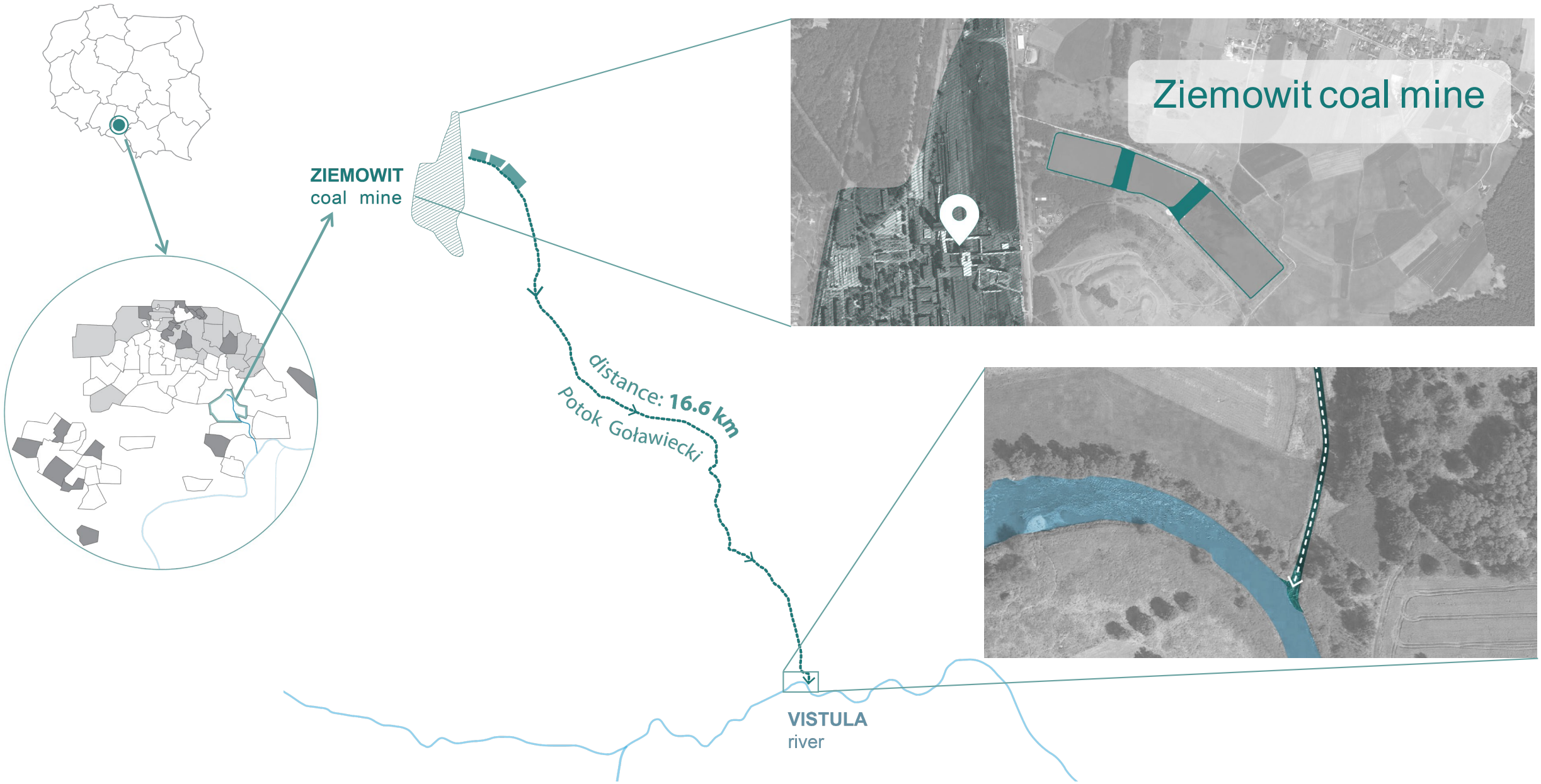
Project Advisor,
EASME,
European Commission

*"The LIFE BRINE MINING project has a significant **policy impact** and **marketability potential** and this has been pivotal for its selection at the evaluation stage."*

European Commissioner,
Mr. Karmenu Vella

GREEN AWARD
BEST OUT OF 4,306 projects
in ENVIRONMENT CATEGORY
30/05/2017


E. Project management and monitoring of the project progress
Action E.1. Project management by NTUA
A. Preparatory actions
Action A.1 Technical planning
A.1.1. Preparation of tender and permit document
A.1.2. Setting the Circular Economy Plan for the coal mine sector in Poland
B. Implementation actions
Action B.1 Engineering, construction and installation of the innovative demonstration system for the treatment of coal mine wastewater
Action B.2 Operation and optimization of the prototype LIFE BRINE MINING system
Action B.3 Replicability and transferability of the project
Action B.4 Business plan and market exploitation
Action B.5 Putting the project results into practice - Development of the circular economy plan for the coal mine sector
C. Monitoring of the impact of the project actions
Action C.1 Monitoring Protocol and Baseline monitoring
Action C.2 Monitoring of process performance
Action C.3 Monitoring the environmental impact of the project
Action C.4 Monitoring the socioeconomic impact of the project
D. Public awareness and dissemination of results
Action D.1. Information and awareness raising activities
Action D.2. Technical dissemination activities


ZIEMOWIT
coal mine
Ziemowit coal mine
distance: 16.6 km
Potok Goławiecki
VISTULA
river

Developing the CE Action Plan

Social Context (stakeholders):

Investors, mine industries, salt suppliers & producers, water suppliers, process industries, science, waste management sector, policy makers, general public, EU coal region platform

Goals, expectation budget etc.

Design

Improving design

Answering knowledge questions

Existing problem-solving knowledge, old designs

New problem-solving knowledge, new designs

Existing answers to knowledge questions

New answers to knowledge questions

Knowledge Context:

brines management, thermodynamic simulation, techno-economic feasibility, business modeling, stakeholder engagement, policy & social sciences

Design cycle

Phase 1: Background studies

Phase 2: Problem identification

Phase 3: Design & development

Phase 4: Design validation

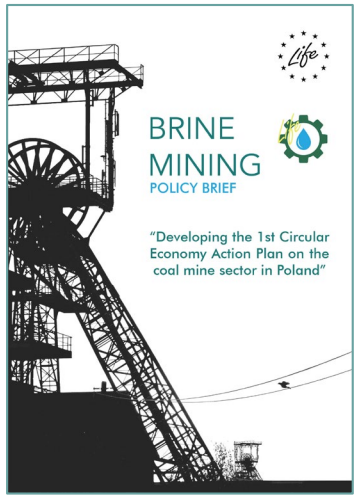
Phase 5: Evaluation

Stakeholder goals met?

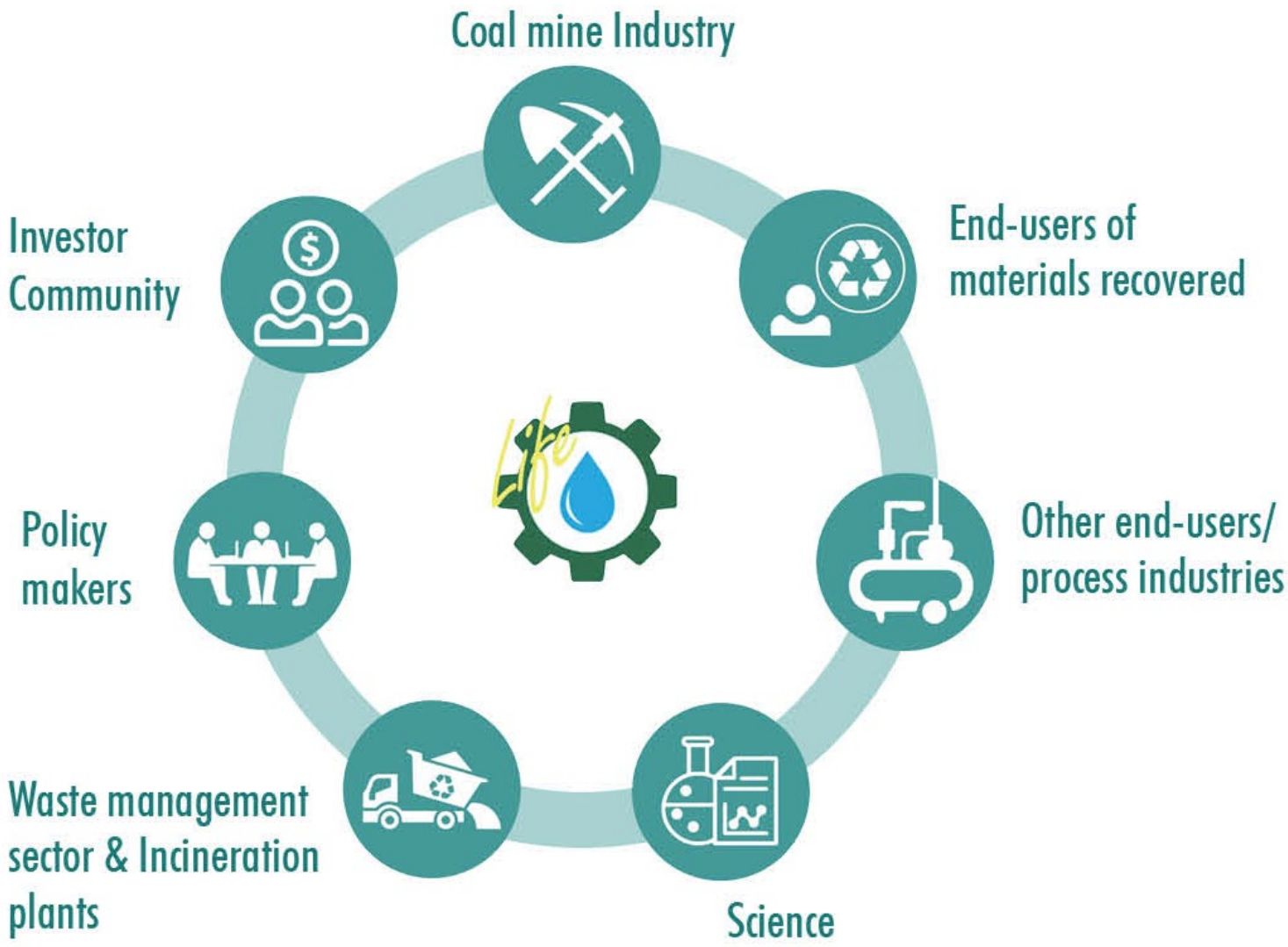
Feedback from stakeholders to improve design

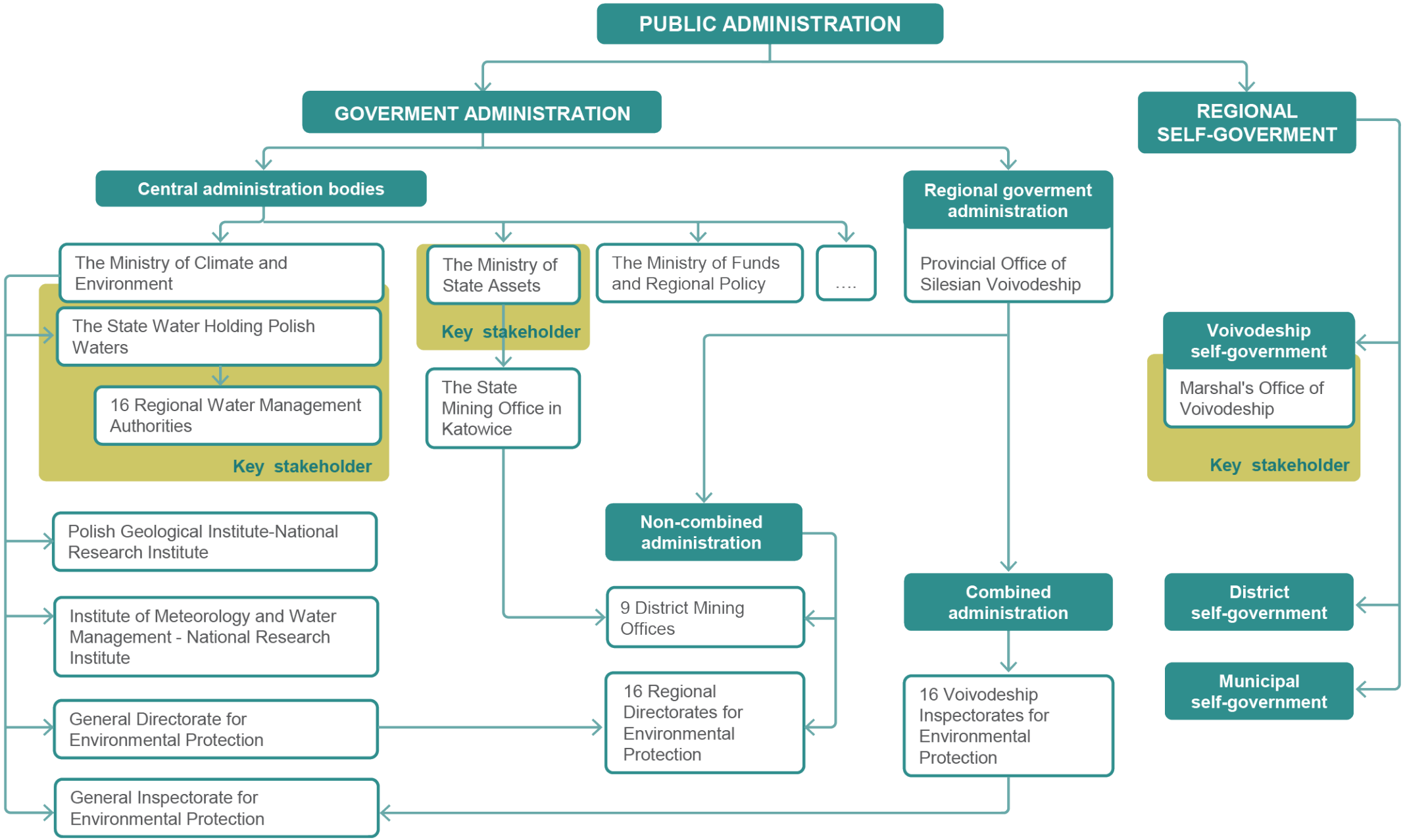
Phase 6: Communication

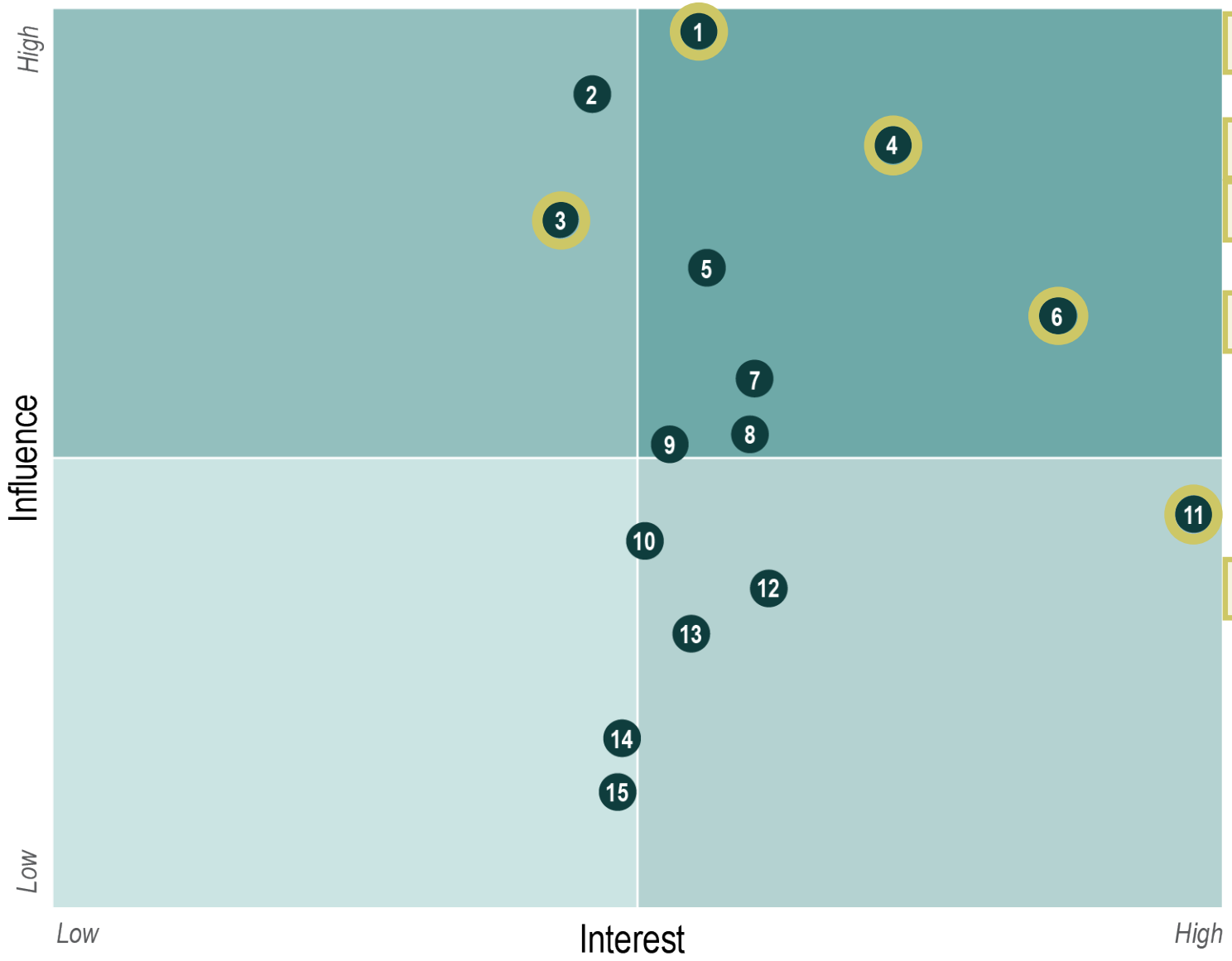
Policy brief



Coal mines in Poland




PUBLIC ADMINISTRATION
GOVERMENT ADMINISTRATION
REGIONAL SELF-GOVERMENT
Central administration bodies
Regional goverment administration
The Ministry of Climate and Environment
The State Water Holding Polish Waters
16 Regional Water Management Authorities
Key stakeholder
The Ministry of State Assets
Key stakeholder
The State Mining Office in Katowice
The Ministry of Funds and Regional Policy
....
Provincial Office of Silesian Voivodeship
Voivodeship self-government
Marshal's Office of Voivodeship
Key stakeholder
Polish Geological Institute-National Research Institute
Institute of Meteorology and Water Management - National Research Institute
General Directorate for Environmental Protection
General Inspectorate for Environmental Protection
Non-combined administration
9 District Mining Offices
16 Regional Directorates for Environmental Protection
Combined administration
16 Voivodeship Inspectorates for Environmental Protection
District self-government
Municipal self-government



1. Ministry of Climate and Environment
2. Ministry of Funds and Regional Policy
3. Ministry of State Assets
4. State Water Holding Polish Waters
5. State Mining Office in Katowice
6. Marshal's Office of Voivodeship
7. General Directorate for Environmental Protection
8. General Inspectorate for Environmental Protection
9. Provincial Office of Voivodeship
10. District Mining Offices
11. Regional Water Management Authorities
12. Regional Directorates for Environmental Protection
13. Voivodeship Inspectorates for Environmental Protection
14. Polish Geological Institute
15. Institute of Meteorology and Water Management

Thank for your attention!

SEALEAU

GIG Research Institute 95 years

slido

Audience Q&A Session

ⓘ Start presenting to display the audience questions on this slide.

Conclusion

Zoe Rasbash

Secretariat of the Initiative for Coal Regions in Transition

Slido.com: CRIT5

Social media: #CoalRegionsEU

Thank you

secretariat@coalregions.eu

Website

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