CENTRAL MINING INSTITUTE

GIG

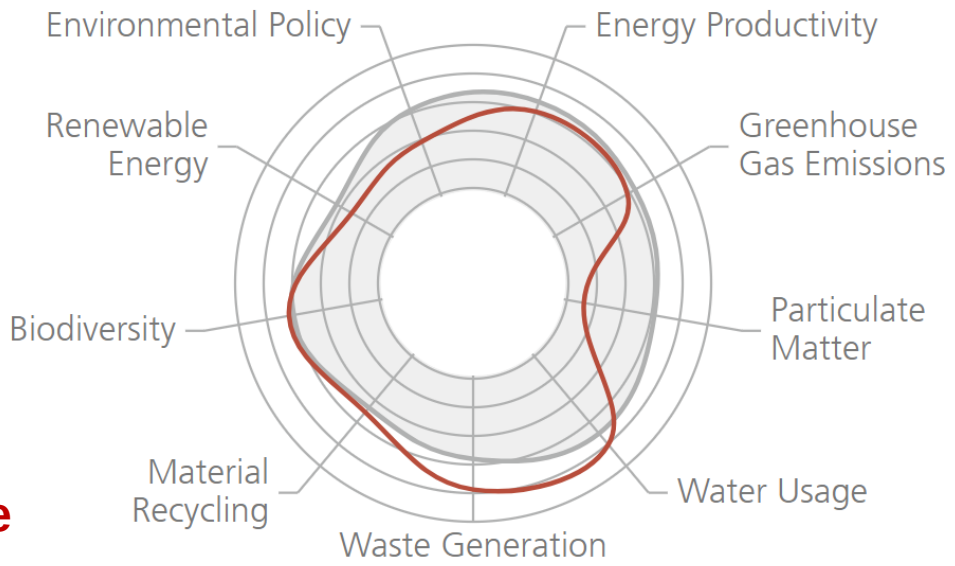
Polish experience in mitigation of environmental hazards in mining areas

ENVIRONMENTAL TRENDS

Poland broadly adopted EU **environmental standards.** Coal production has dominant position in Polish energy mix. Renewables are gradually implemented. Poland remains most material- and energy-consuming economies of the European Union (EU) in terms of efficiency.

Due to extensive development of new investment **environmental resources are under the pressure of different hazards.** Environmental impact assessment (EIA) in Poland is fully respected and has a tradition extending back to the 1980s.

Winter time brings the highest levels of smog (PM10, PM2,5 and carcinogenic benzo[a]pyrene as well as nitrogen and sulphur compounds). Therefore **Poland has failed to meet EU air quality requirements.**



Sustainable Governance Indicators 2017, Poland report 2017 made by Bertelsmann Stiftung

For the last decade the **total amount of industrial waste has remained at a relatively similar level**. Its main source is mining, quarrying and manufacturing.

EU DIRECTIVES – ENVIRONMENTAL DRIVERS

2020 climate and energy package + EU Clean Air Package

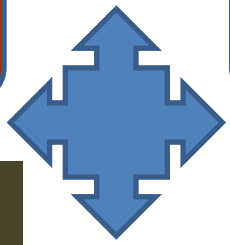
low-carbon, ETS and emmision limits incl. winter package, BAT

CO_2 utilisation technologies (CCS, CCU), new combustion schemes and analysis of fuel

Circular economy package + Action Plan

Polish Road Map towards CE

closing the loop and significant reduction in the amount of residual waste generated, Ecodesign -> 4R



Water Framework Directive

New Water Act (2017) and water resources governance (Polish Water)

management of discharge and monitoring of water quality, payment system for ‘water services’.

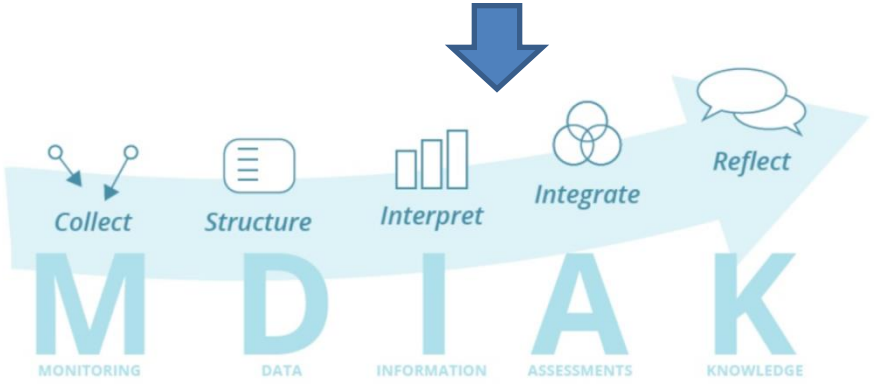
Council Directive 2013/59/Euratom (BSS)

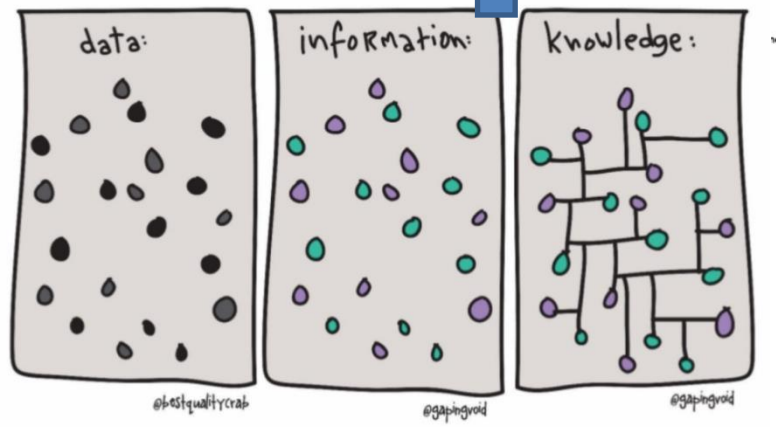
New safety standards related to ionizing radiation, radon exposure

underground workplaces and places related to the treatment of water extracted from underground sources

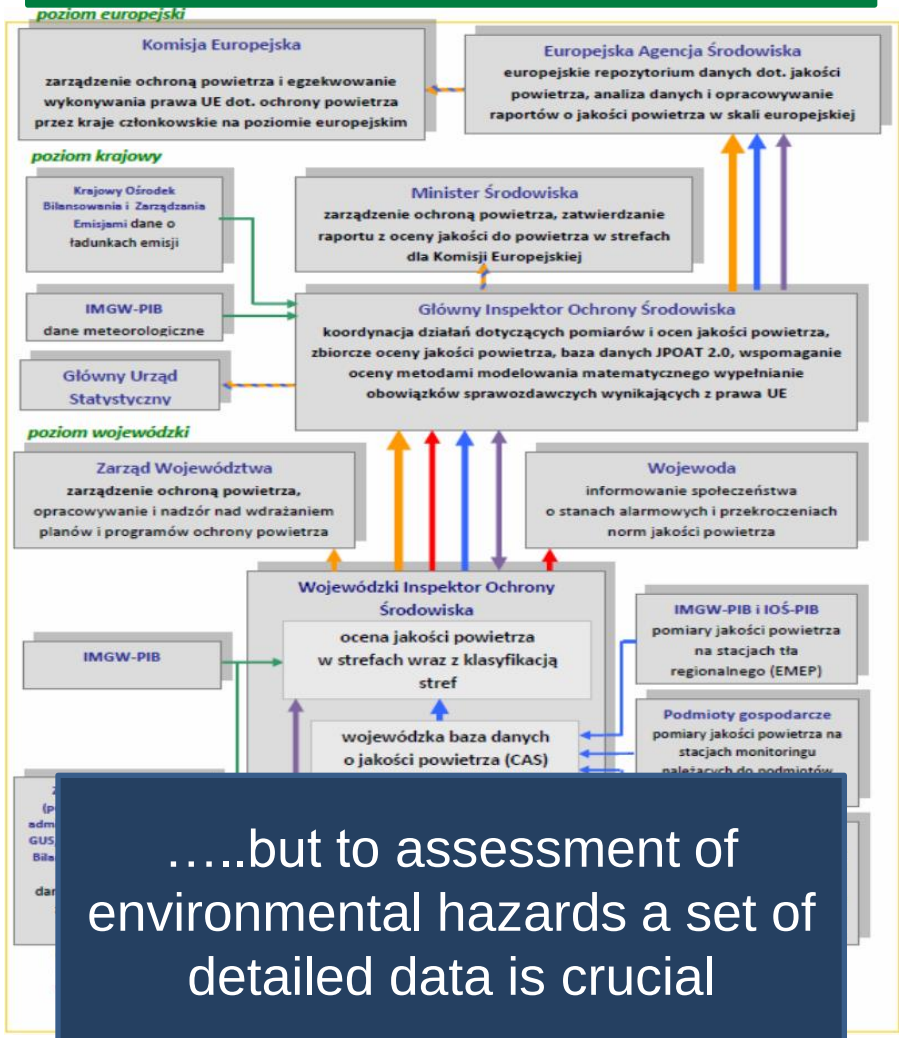
NATIONAL MONITORING SYSTEM

Environmental resources and impacts are constantly analysed and assessed. Nationl monitoring system has different division and reporting schemes (botto-up) incl. national and EU levels.





AIR POLLUTION REPORTING SCHEME



…..but to assessment of environmental hazards a set of detailed data is crucial

ENVIRONMENTAL ENGINEERING CENTRE (EEC)

GIG

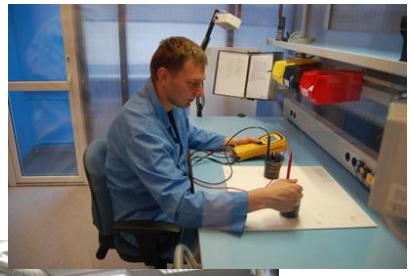
The EEC provides comprehensive R&D works, services and expertise in terms of environmental engineering and green economy sector.

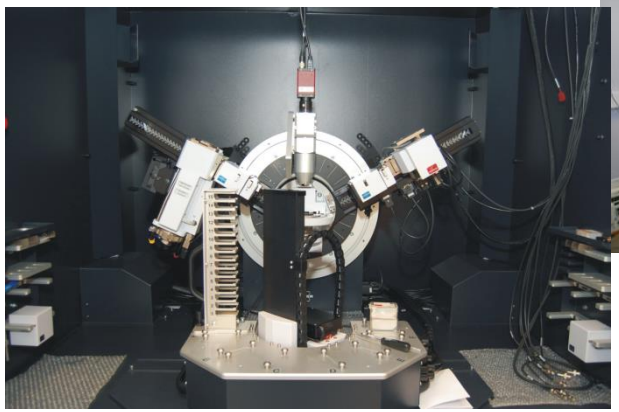
New **technologies, products and solutions** to mitigate the impact on the environment, supporting the protection of resources and their sharing in accordance with the principles of sustainable development are developed and implemented. Broad range of **environmental services** supported by accredited laboratories are provided.

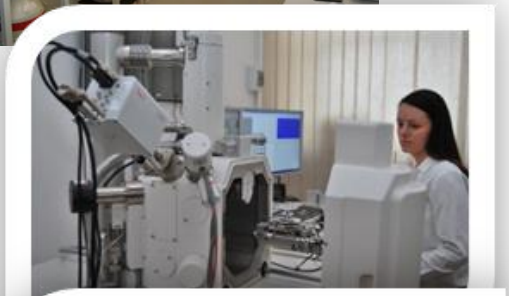
We know how to balance industry and environment

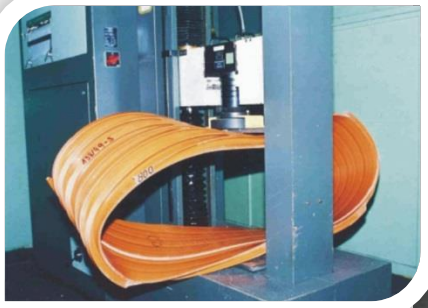
R&D STAFF and INFRASTRUCTURE

Experts and research teams of GIG provide multidisciplinary services supporting industry, regional and local authorities as well as government institutions.



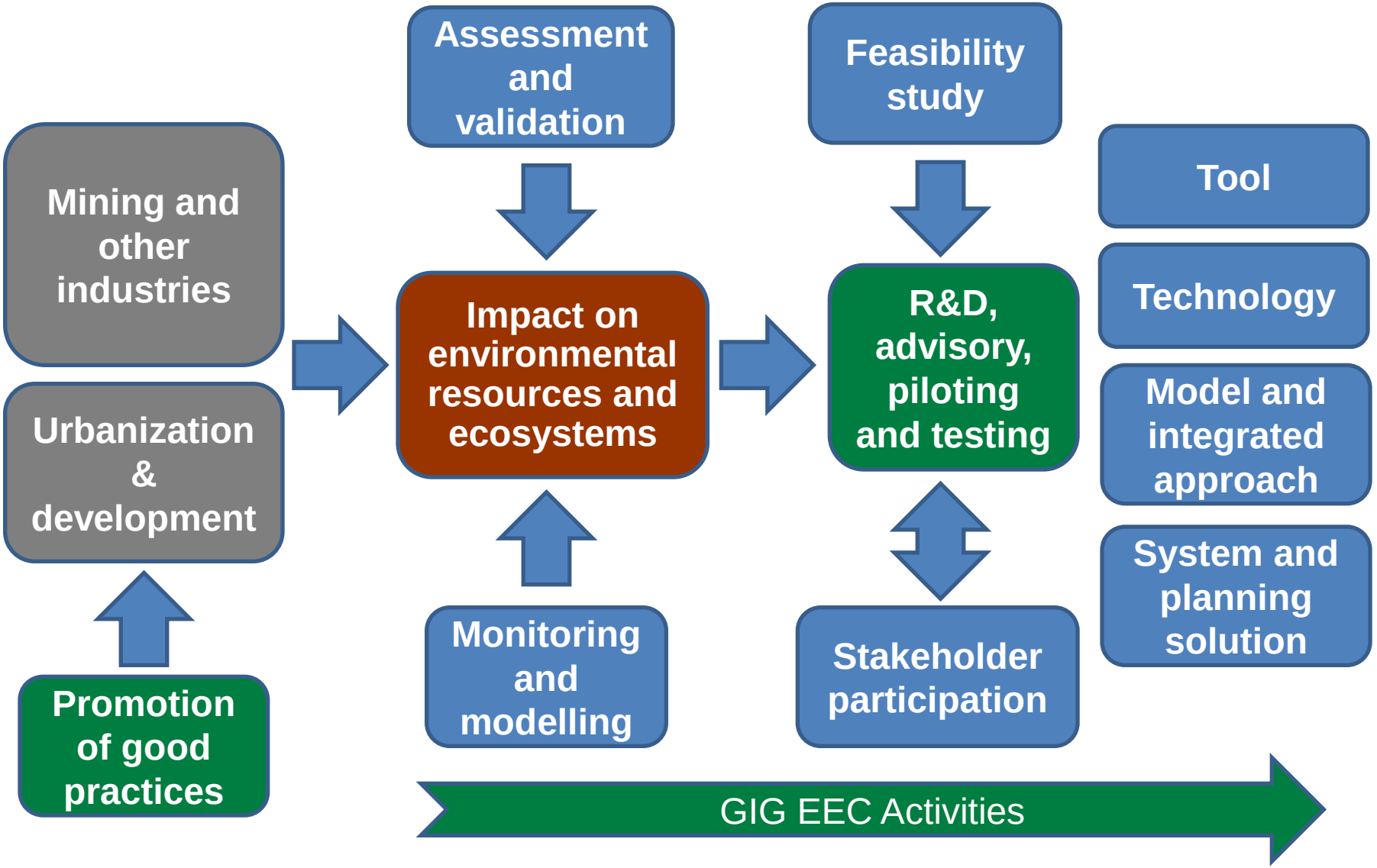




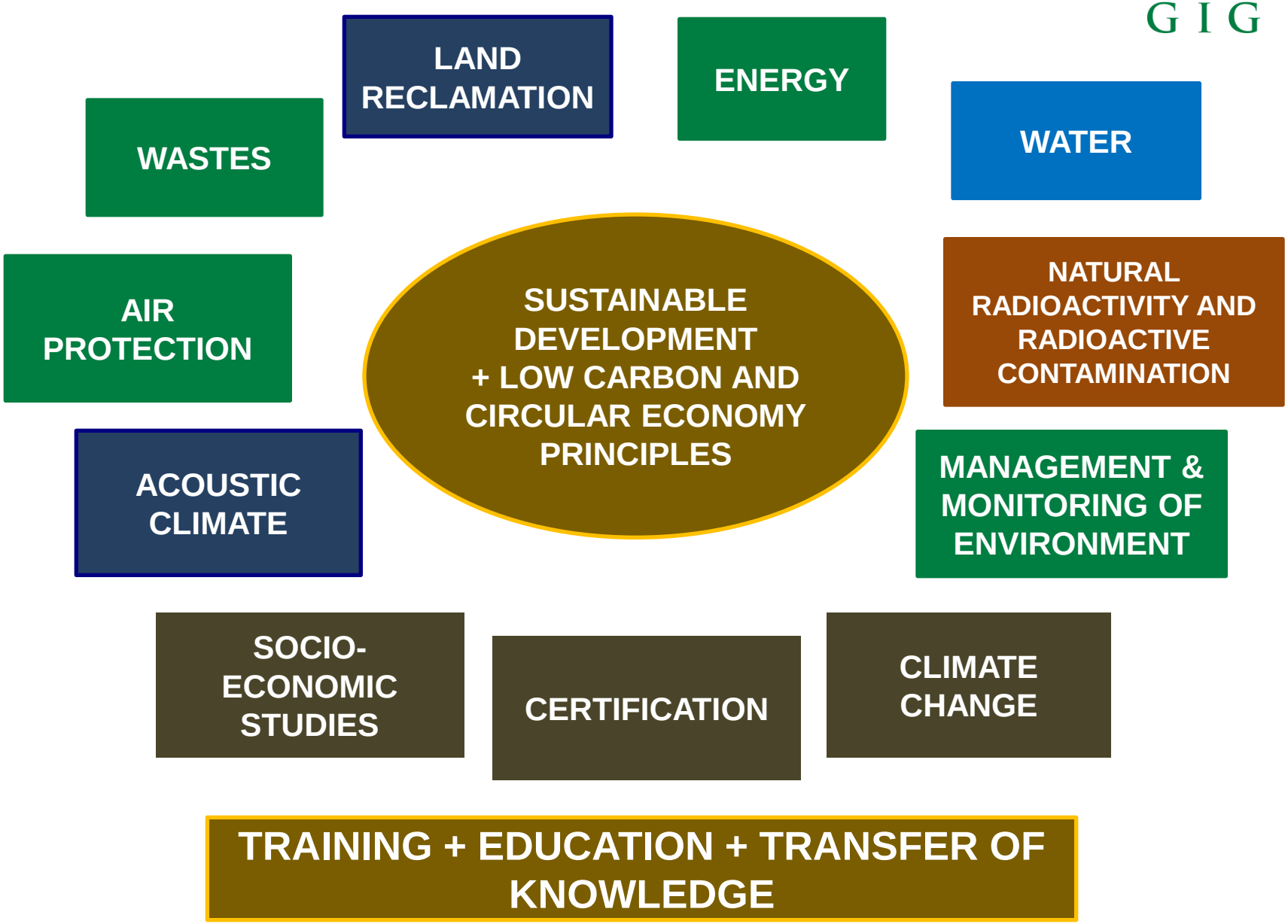


MITIGATION OF E-HAZARDS COMPETENCES

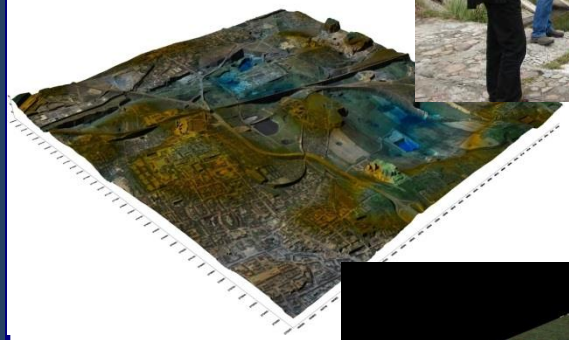
GIG

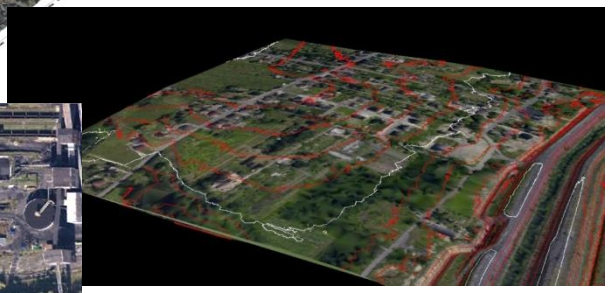


EEC DOMAINS


LAND RECLAMATION
ENERGY
WASTES
WATER
AIR PROTECTION
SUSTAINABLE DEVELOPMENT + LOW CARBON AND CIRCULAR ECONOMY PRINCIPLES
NATURAL RADIOACTIVITY AND RADIOACTIVE CONTAMINATION
ACOUSTIC CLIMATE
MANAGEMENT & MONITORING OF ENVIRONMENT
SOCIO-ECONOMIC STUDIES
CERTIFICATION
CLIMATE CHANGE
TRAINING + EDUCATION + TRANSFER OF KNOWLEDGE

REVITALISATION OF FORMER MINING SITES





DEGRADED AND VACANT AREAS

Excavation

Flotation dumps

Illegal landfill

49 different type of degradation has been specified

Heaps

Post-mine objects and areas

Quarry

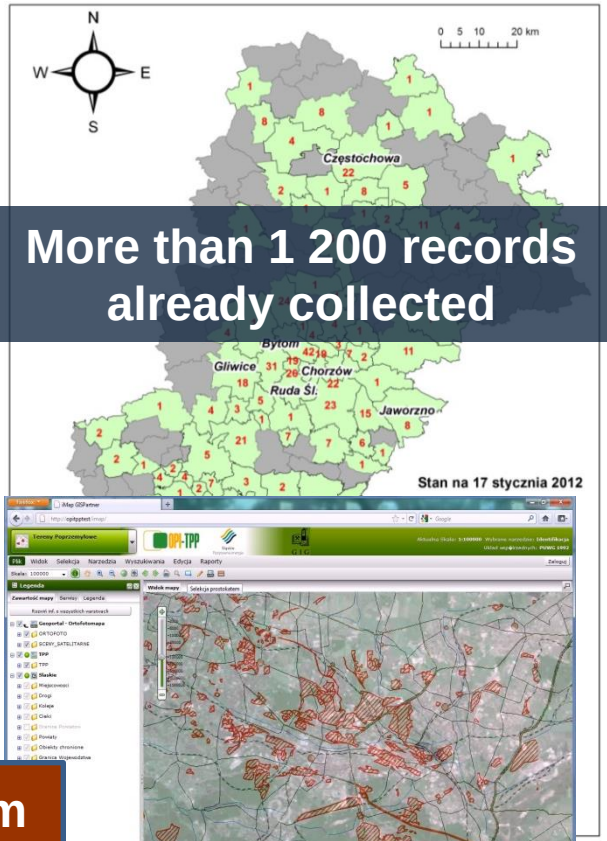
Post-industrial areas management IT tool

GIG

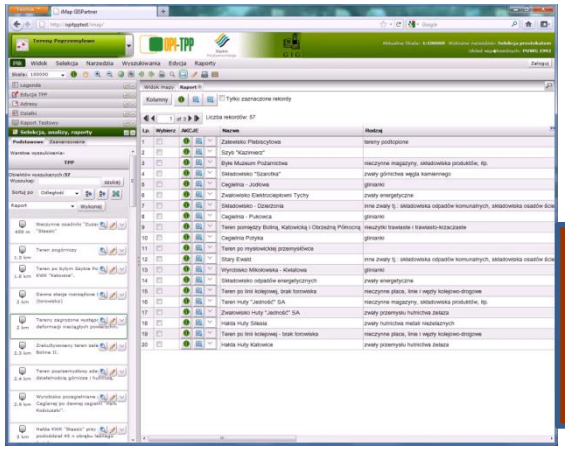
OPI-TPP

Information Platform "Post-industrial and degraded areas" (OPI-TPP) innovative tool supporting spatial management by identification of possible environmental and social conflicts

- ✓ Public accessible and comprehensive IT tool for acquiring, processing and sharing data on industrial areas
- ✓ Integration of different data sources in connection with spatial information
- ✓ Revitalisation scenarios, environmental assessment and conflict identification analysis



More than 1 200 records already collected



Advanced raports and analysis – easy to access easy to generate

Project to upgrade the system has been submitted to Coal Regions in Transition Platform

Resources of post-mining areas

GIG

Low-Carbon After-Life (LoCAL): sustainable use of flooded coal mine voids as a thermal energy source – a baseline activity for minimising post-closure environmental risks

Research Fund for Coal and Steel, in cooperation with Spanish and English partners.

LoCAL project brings together the state-of-the-art in modelling & management of abandoned coal mine workings for use the mine water as a heat source.

LOw Carbon After Life: LOCAL sustainable use of flooded coal mine voids as a thermal energy source - a baseline activity for minimising post-closure environmental risks

Green energy, carbon footprint

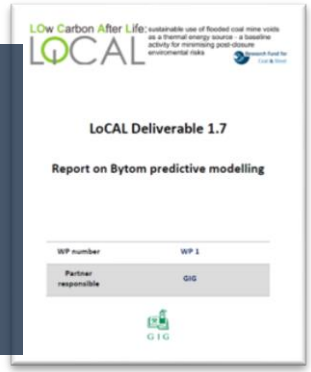
- **development of tools for investigating flow and heat transfer,**
- **scrutiny and testing of ways for overcoming the hydrochemical barriers to effective heat transfer from raw and treated mine waters,**
- **development of models for efficiency of energy extraction and distribution – especially including STEEP, DGC, risk and sensitivity analyses, as well as ownership, management and financial models,**
- **implementation and monitoring of pilot plants at sites in the UK, Spain and Poland (former KWK Szombierki - Bytom).**

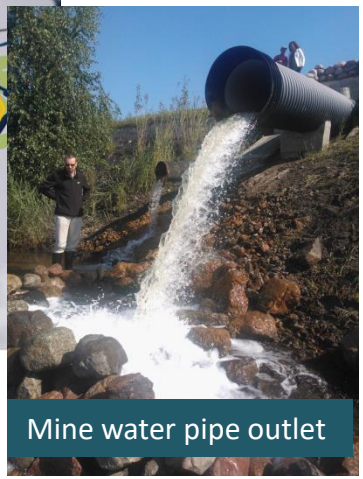
Resources of post-mining areas

GIG

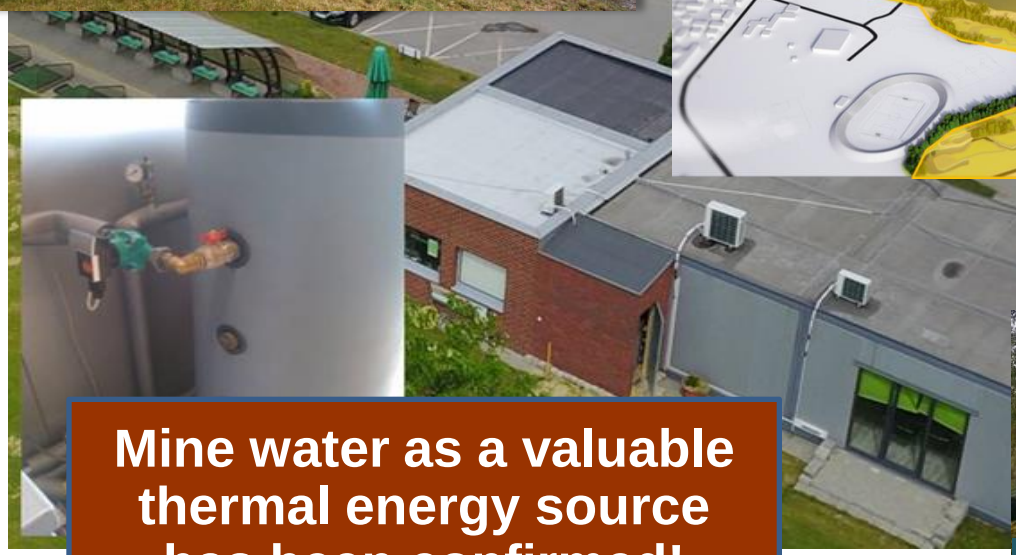
The former coal mine Szombierki has been transformed into the green land and creating a new leisure and residential area

The amount of mine water pumped from "Ewa" shaft is around 5 m^3/min (83 L/s), while the temperature varies from 24 to 28^{0}C





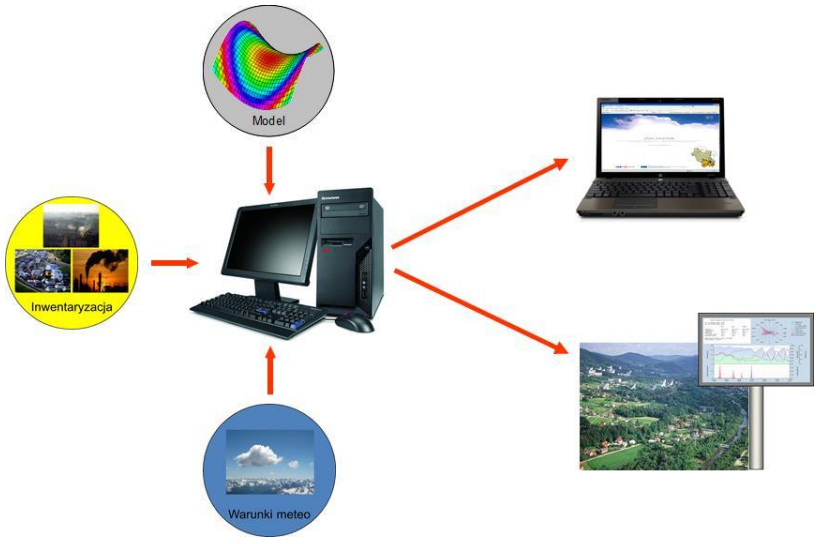
Mine water pipe outlet



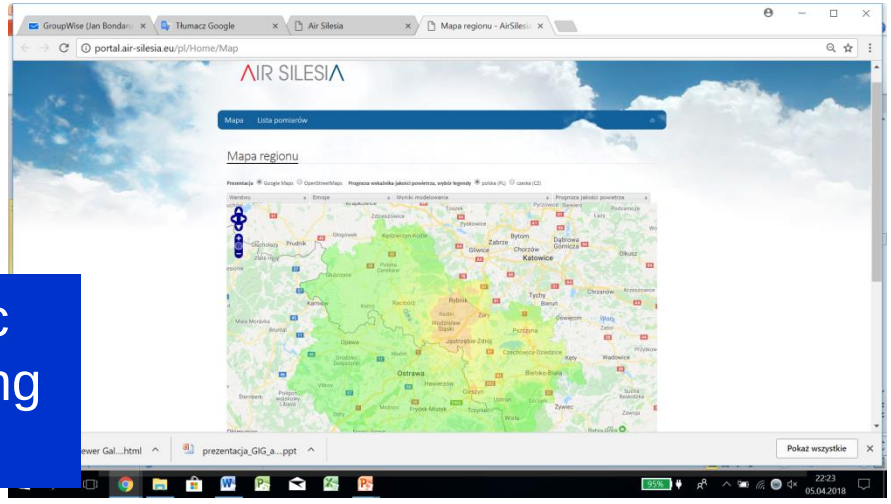
Mine water as a valuable thermal energy source has been confirmed!

Construction works

AIR PROTECTION & AIR QUALITY MONITORING



Air-Silesia

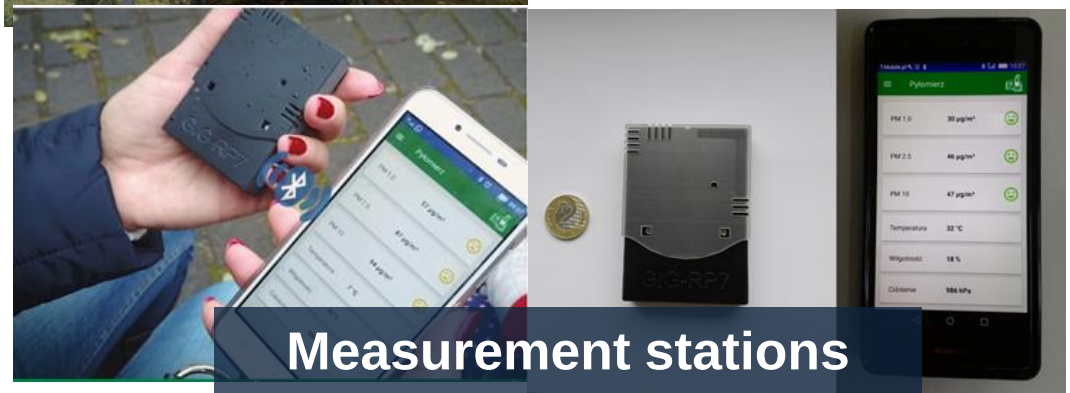


Poland and Czech Republic boarder - air quality monitoring system + modelling tools

AIR MONITORING SYSTEM

Mobile measurement platform – Eko-patrol GIG

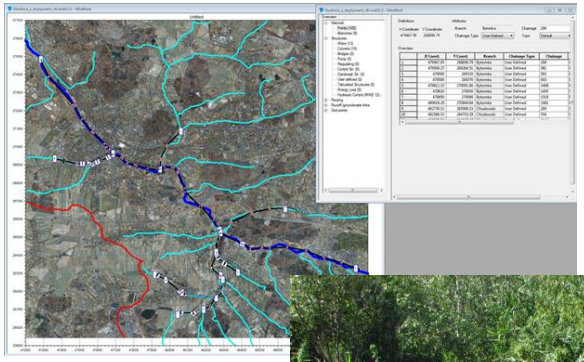
Analysis
Visualisation



Alerts
Info, Reports

Measurement stations and personal sensors

MITIGATION OF WATER HAZARDS



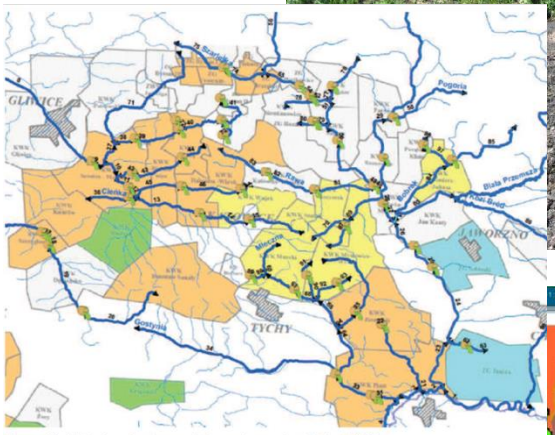
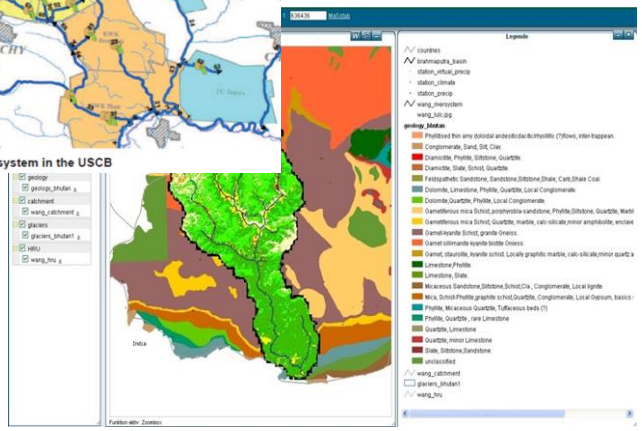


Figure 13. Water tree for the receiving water system in the USCB

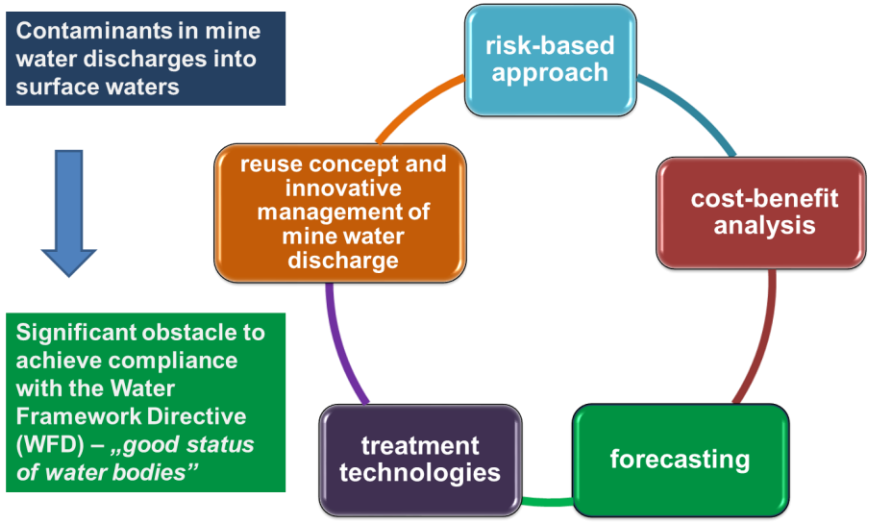


Mitigation of water hazards in practice

Management of mine water discharges to mitigate environmental risks for post mining period – MANAGER Project

Research Fund for Coal and Steel (international

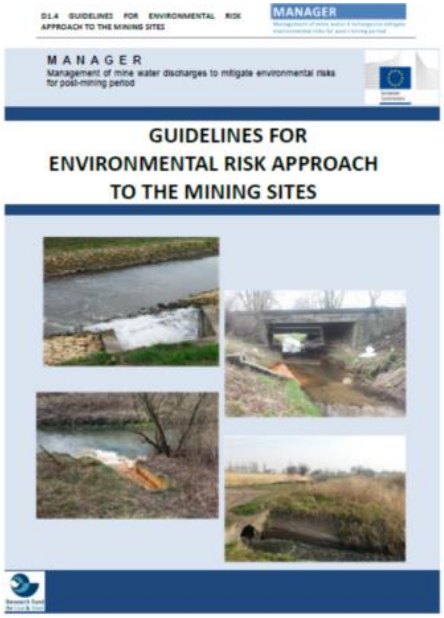
- Development and implementation of cost-effective, sustainable and innovative mine water treatment technologies -> **to mitigate the environmental risks with reference to WFD**,
- Solutions for further use of treated water and substances/products of treatment processes,
- Development of innovative management approaches to mine water discharge and treatment –> **management of discharge**,
- Pilot investments for assessing technical and economic feasibilities of identified and tested technologies.



Guidelines and good practices

GIG

Technology selection routine



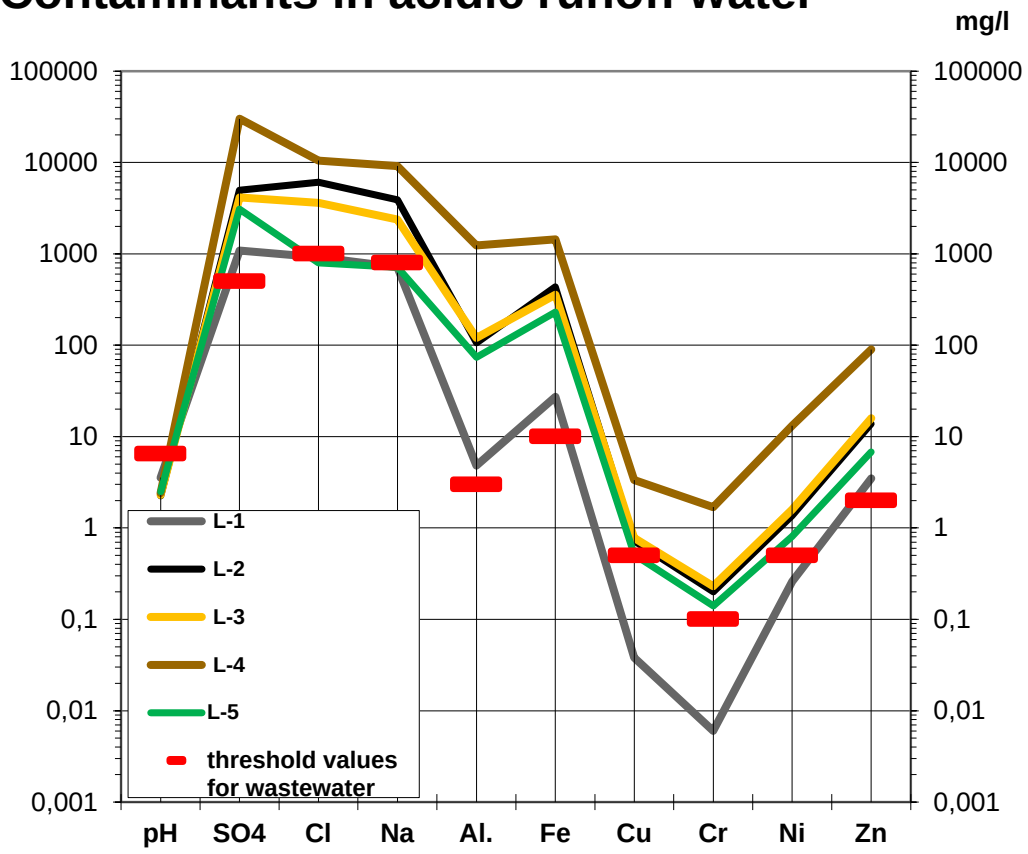
The approach developed in the project MANAGER enables significant progress in planning and designing of mine water treatment and discharge systems, qualitative and quantitative correlations between environmental and technological scenarios

ACIDIC COAL MINE DRAINAGE HAZARD

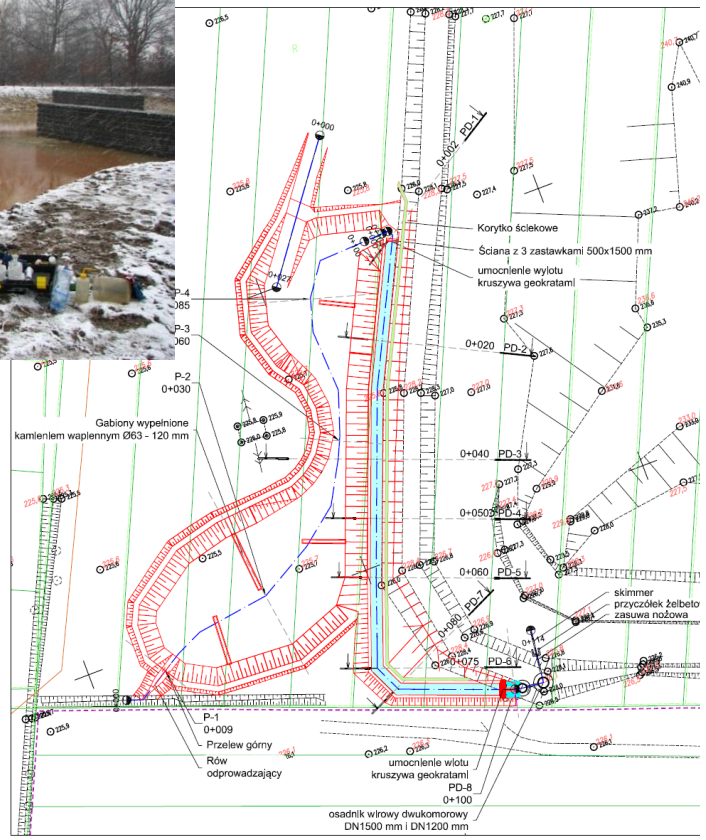
GIG

$$FeS_2 + 3.5O_2 + H_2O \rightarrow Fe^{2+} + 2SO_4^{2-} + 2H^+$$

Contaminants in acidic runoff water



Periodical acting and alkalinity producing system



implementation of GIG owned technology – installation for neutralisation of acid rock drainage from mining wasteland

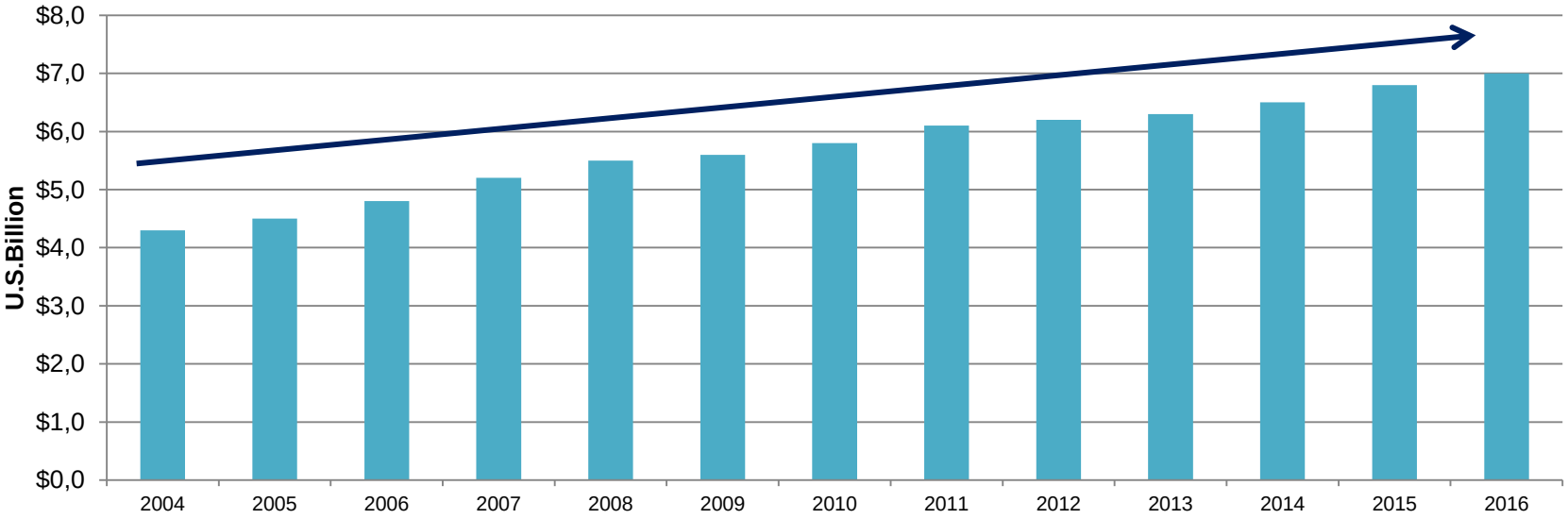
WASTE MANAGEMENT AND RARE METALS RECOVERY

CIRCULAR ECONOMY PRIORITIES

GIG

The key operations towards a circular economy

Poland's Environmental Technologies Market

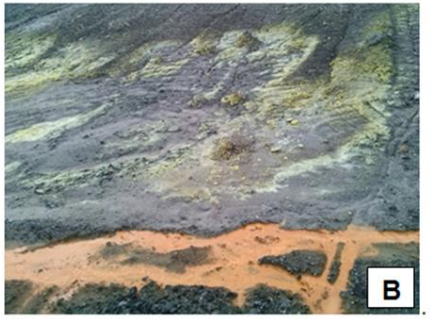


Source: Environmental Business International with OEEI analysis, 2016 [in *The Circular Economy:Challenges and Opportunities*]

Waste recovery technologies (waste to product)

CEReS - Co-processing of coal mine and electronic: Novel resources for a sustainable future

Project aims to introduce a series of technological improvements to reduce the risks associated with managing **existing and future coal production wastes** and coming from current production (acidic AMD leachate) and PCB waste coming from waste electrical and **electronic equipment.**

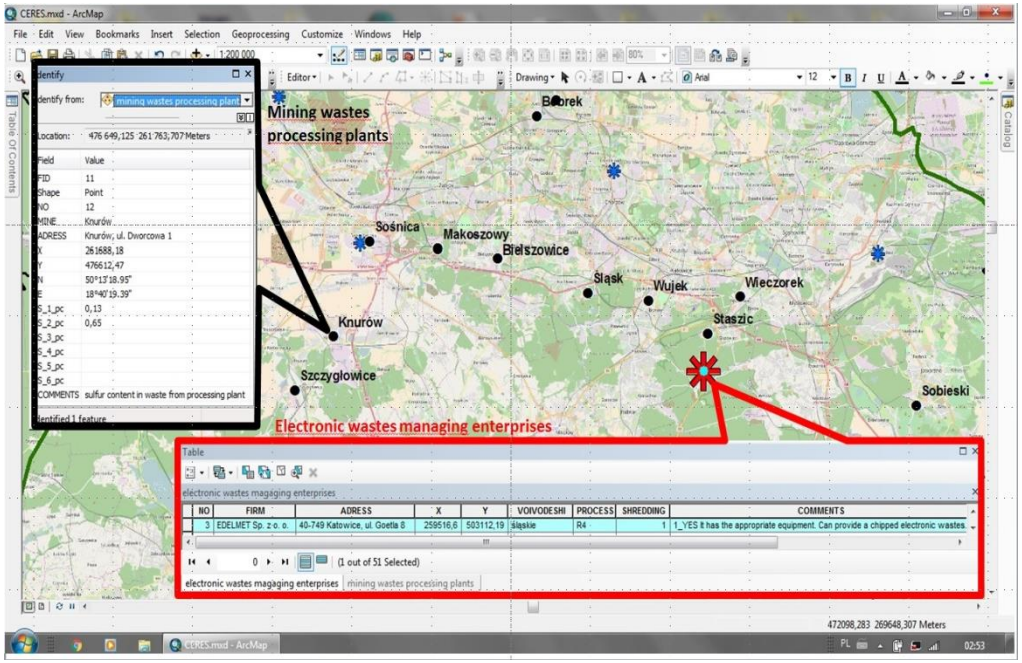


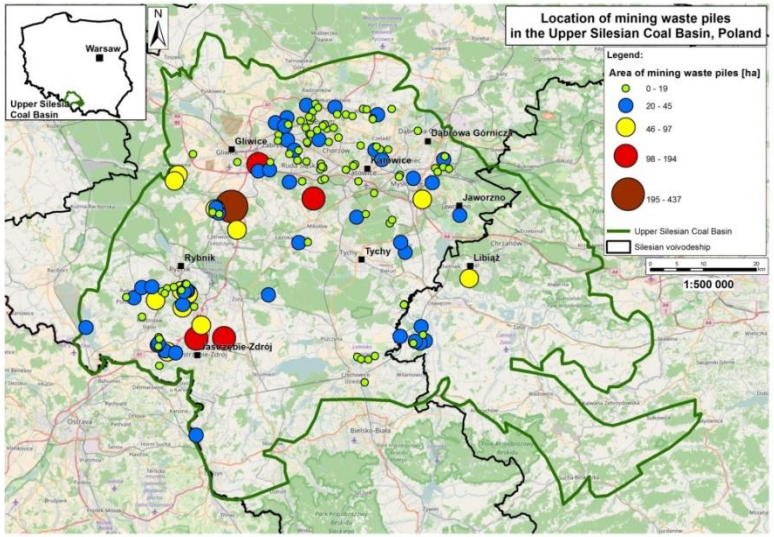
Project is implemented in an international consortium (UK, Poland, France, Belgium). Financed from RFCS. Implementation period: 2016-2019

KNOWLEDGE BASE

GIG

The task of GIG is to prepare and characterize waste for research, to prepare cross-mapping for post-mining and electronic waste for the territory of Poland and to develop innovative application for desulfurized post-mining waste in the field of material geoengineering.





Location of mechanical coal processing plants and electronic waste management enterprises in the south of Poland

Location and area of hard coal mining waste dumps at Upper Silesian Coal Basin

Database of 152 coal waste dumps and coal waste storage facilities. Area of more than 3982 ha. The total waste deposit has a volume of more than 300 million m3 and a mass of 627 million Mg

RARE METALS RECOVERY

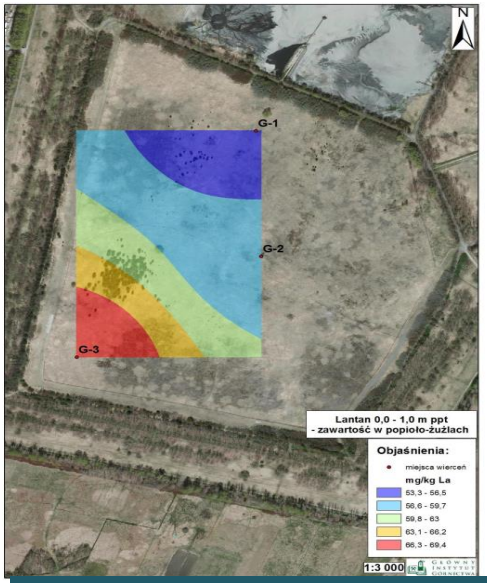
PROJECT: **Assessment of possible recycling directions of heavy & rare metals recovered from combustion waste products – acronym: RAREASH**

FINANCED BY: 2nd ERA-MIN Joint Call

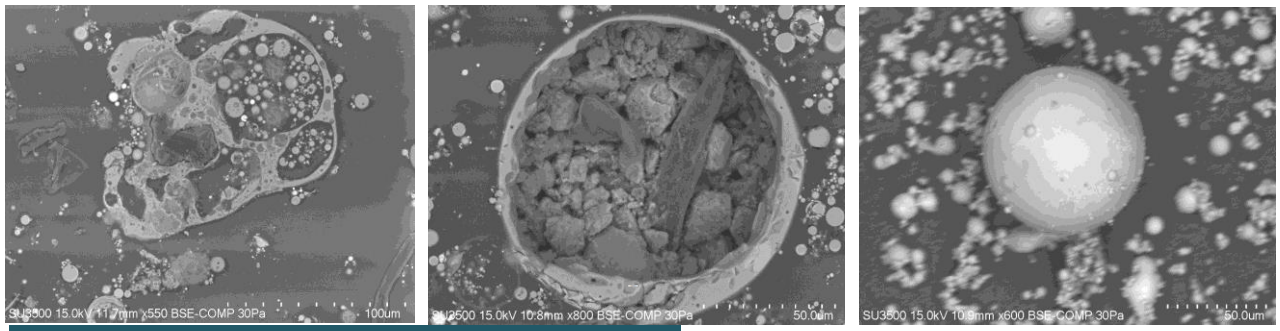
PROJECT LOCATION: **Romania, Portugal, Poland**

DURATION: **36 months (2015-2018)**.

Developing metal recovery processes and transform wastes (such as Coal ashes) into high-grade and valuable metals (La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Sc, Y, Ga, Sr, Rb, W) with various applications, creating the possibility for a fast access to critical elements and a widespread saving of primary mineral resources



The lanthanum content in Gardawice landfill



Ash from Power Plant Rybnik Poland - SEM EDS

21 Sc 44.956														
39 Y 88.906														
57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
LREE								HREE						

Case study

Initial concentrates of rare earth elements from fly ashes – investigation study

GIG evaluated the possibility of applying physico-chemical (processing) as well as hydrometallurgical (digestion with acids) methods **to obtain initial concentrates of rare earth elements from fly ashes produced in the process of hard coal combustion.**

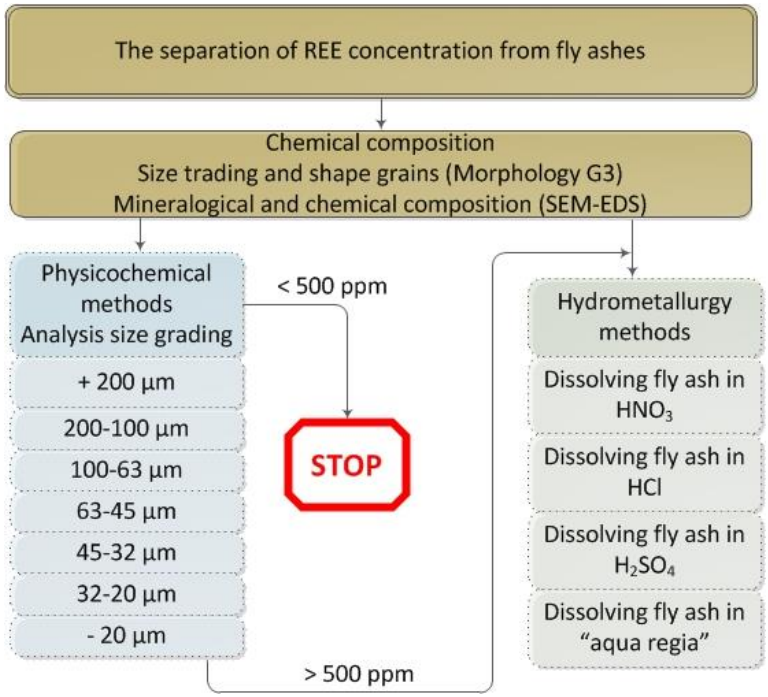


Diagram of the conducted experimental research

New products and application in construction sector

NATURAL RADIOACTIVITY AND RADIOACTIVE CONTAMINATION

SILESIAN CENTRE FOR ENVIRONMENTAL RADIOACTIVITY

Hazard prevention and control

Radiological protection | Radioecology | Environmental radioactivity | Pollution

Radiochemical laboratory
(work with unsealed and liquid sources of radiation)

SILESIAN CENTRE FOR ENVIRONMENTAL RADIOACTIVITY

- Radioactivity in solid samples (sediments, building materials, soil, wastes, biological, etc.)
- Radioactivity in liquid samples (drinking water, mine water, etc.)
- Radioactive pollution of air
- Dosimetry (individual and environmental)
- Radon in soil and air
- Expertise
- Protection systems

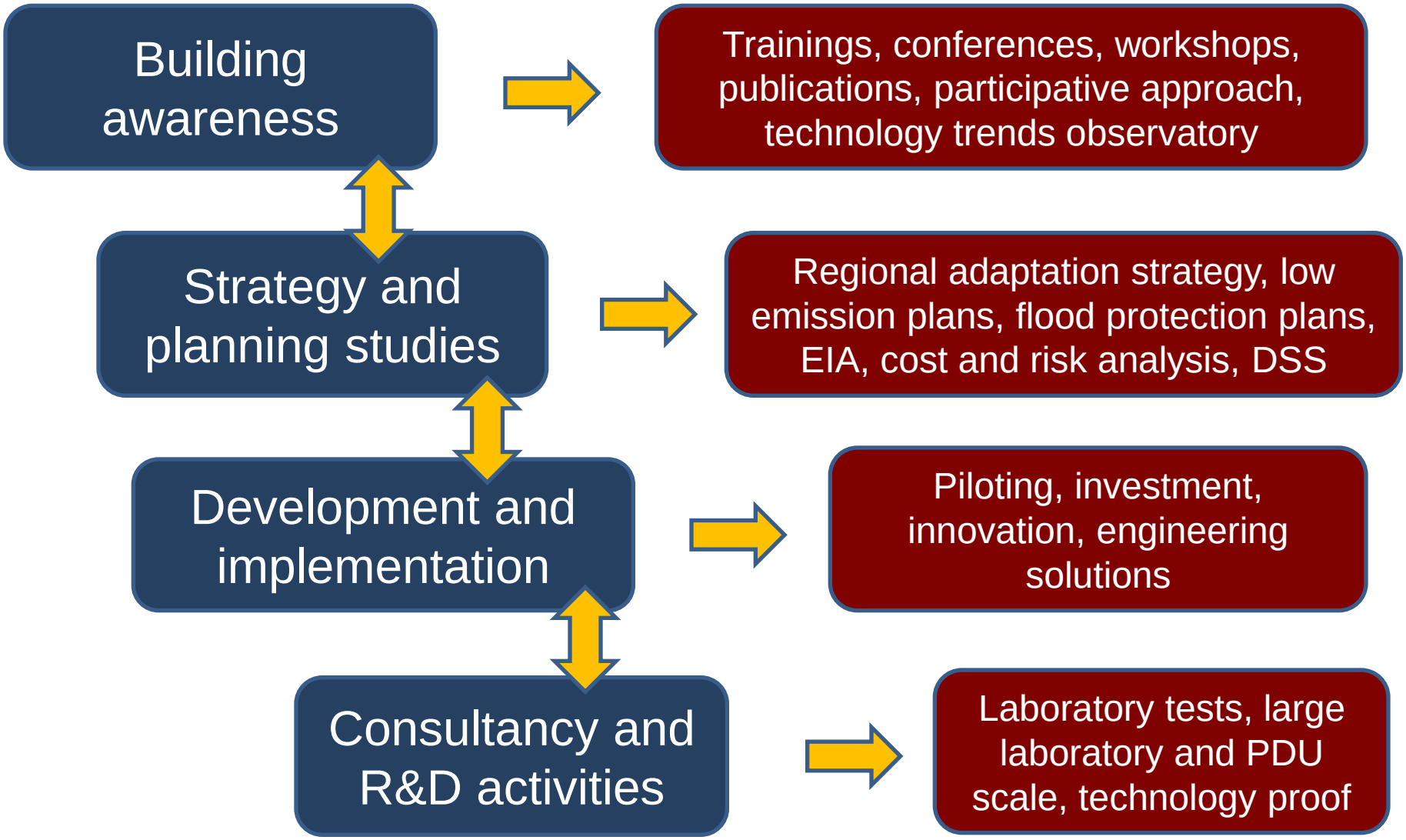
NORM materials

Radioctive pollution of the environment may be caused not only by uncontrolled release of radioactivity from nuclear power plant but also by NORM materials (Naturally Occurring Radioactive Materials) from non-nuclear industries. Such waste materials contain elevated concentrations of natural radionuclides (for instance uranium ore) or enhanced concentrations of radionuclides due to technological processes (ash and slag from coal combustion). Most of these radionuclides can be identified with use of high resolution gamma spectrometry….

High-resolution, low background gamma spectrometric laboratory

Detektor	Zakres energetyczny [keV]	Tlo-caly zakres [cps]	Typ/wyposażenie
Coaxial	40 – 1907	3,00	n-Type
Coaxial	50 – 1947	2,61	p-Type
BEGe	15 – 1791	1,43	ISOCS & LabSOCS
XtRa	5 – 1949	2,51	ISOCS & LabSOCS
Well	10 – 1818	0,51	Aktywna oslona antykoincydencyjna „Annulus”

HOW TO SUPPORT MITIGATION PROCESSES?



THANK YOU FOR ATTENTION

Jan BONDARUK
Deputy General Director
for Environmental Engineering
Central Mining Institute
Plac Gwarków 1
40-166 Katowice
Poland
t: +48 32 259 24 66
f: +48 32 259 21 54
m: +48 512 293 850
jbondaruk@gig.eu
www.gig.eu