12th International Forum on Energy for Sustainable Development

Polish experience with mine closure
- A Research Fund for Coal and Steel approach -

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Coal industry in transition: state of affairs of coal mine closure in the selected UNECE member States - challenges, lessons learned, ongoing projects, perspectives for the future.

Jaworze, Poland - 09.11.2022

RFCS PROJECTS: MERIDA, POTENTIALS & GreenJOBS

MERIDA
RFCS RESEARCH PROJECT

Management of environmental risks during and after mine closure. Grant Agreement No RFCR-CT-2015-00004.

POTENTIALS
RFCS AM PROJECT

Synergistic POTENTIALS of end-of-life coal mines and coal-fired power plants, along with closely related neighbouring industries: update and re-adoption of territorial just transition plans. Grant Agreement No 101034042. www.potentialsproject.eu

GreenJOBS
RFCS RESEARCH PROJECT

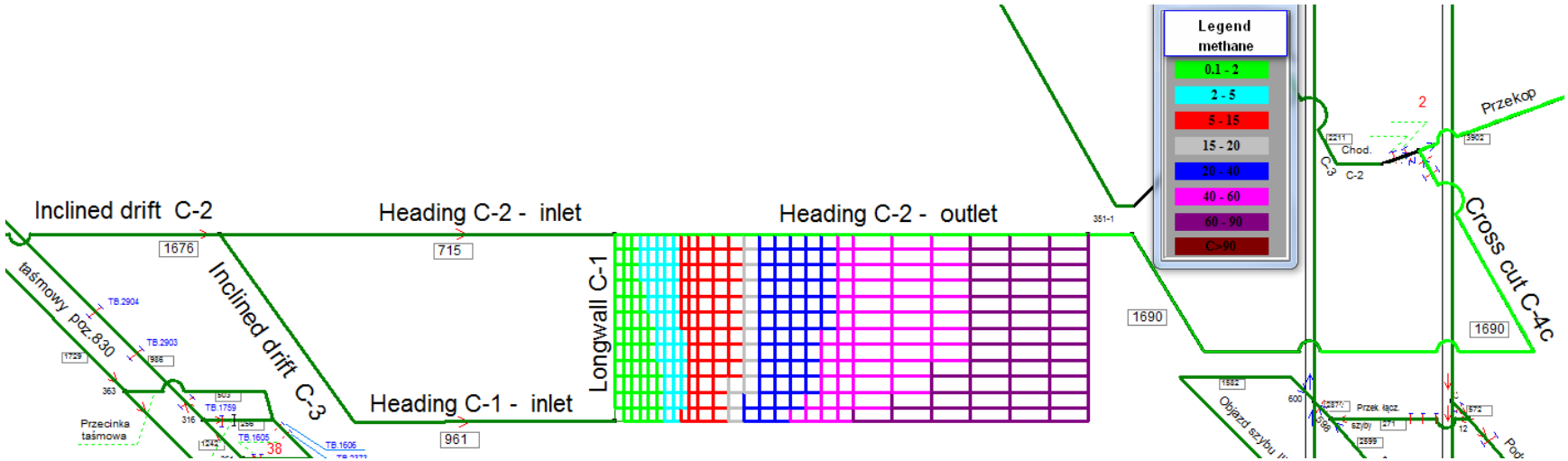
Leveraging the competitive advantages of end-of-life underground coal mines to maximise the creation of green and quality jobs. Grant Agreement No 101057789. www.greenjobsproject.eu

GIG Research Institute

MERIDA Project

The objective of the MERIDA project was to design and provide technical guidance on the implementation of necessary investigations that should be undertaken in order to develop a mine closure plan.

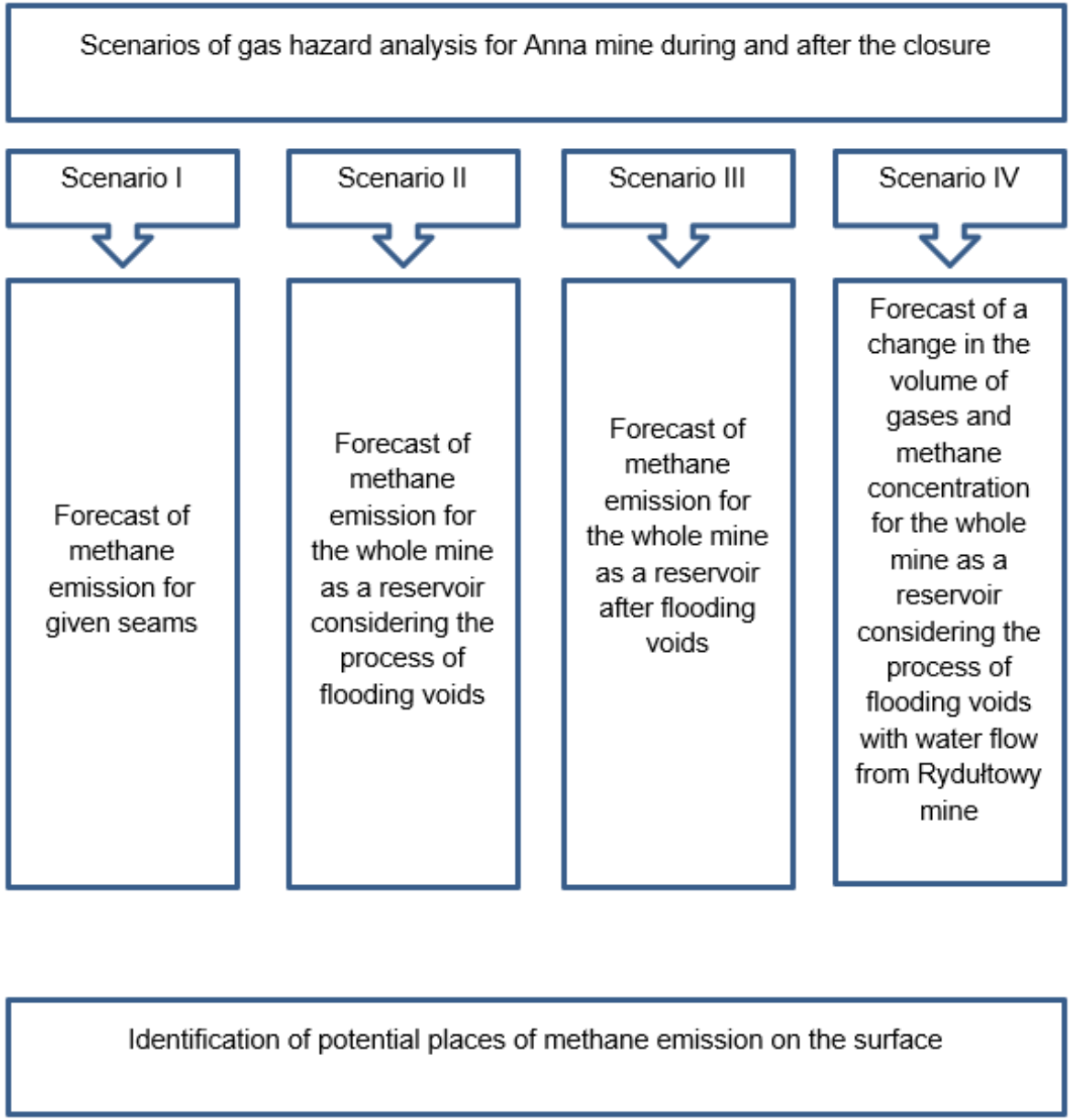
The aim was to minimise the environmental risks during the mine closure and the post-closure periods in accordance with the general principle that the mine must take responsibility and minimise all risks that can be foreseen.



An example of methane distribution calculation in a system of connected goaf and mine ventilation network

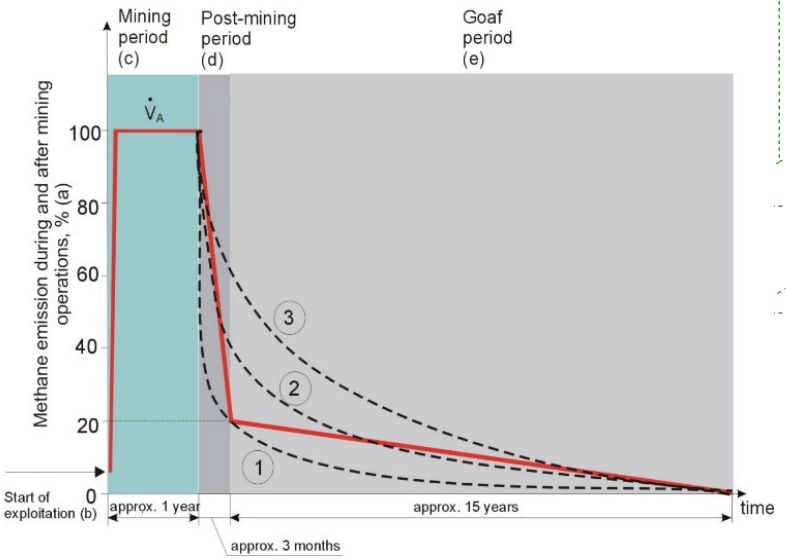
MERIDA Project

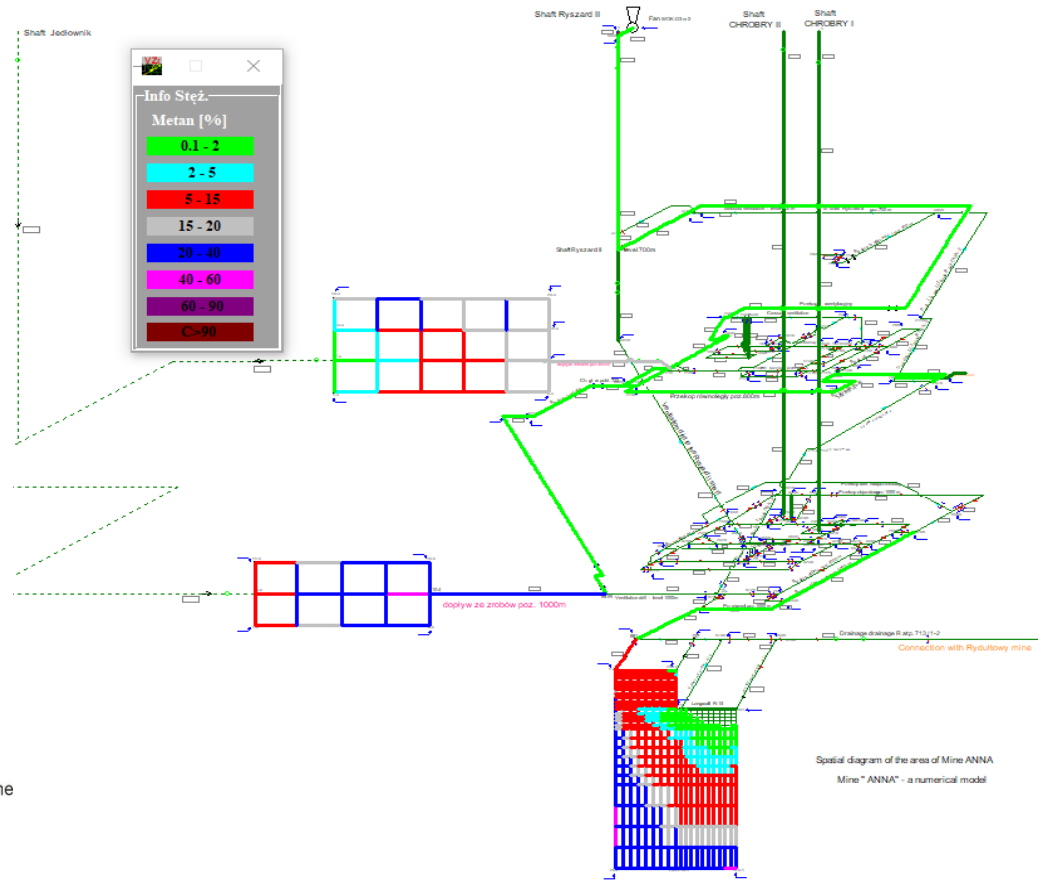
Scenarios of gas hazard analysis for Anna mine during and after the closure



MERIDA Project

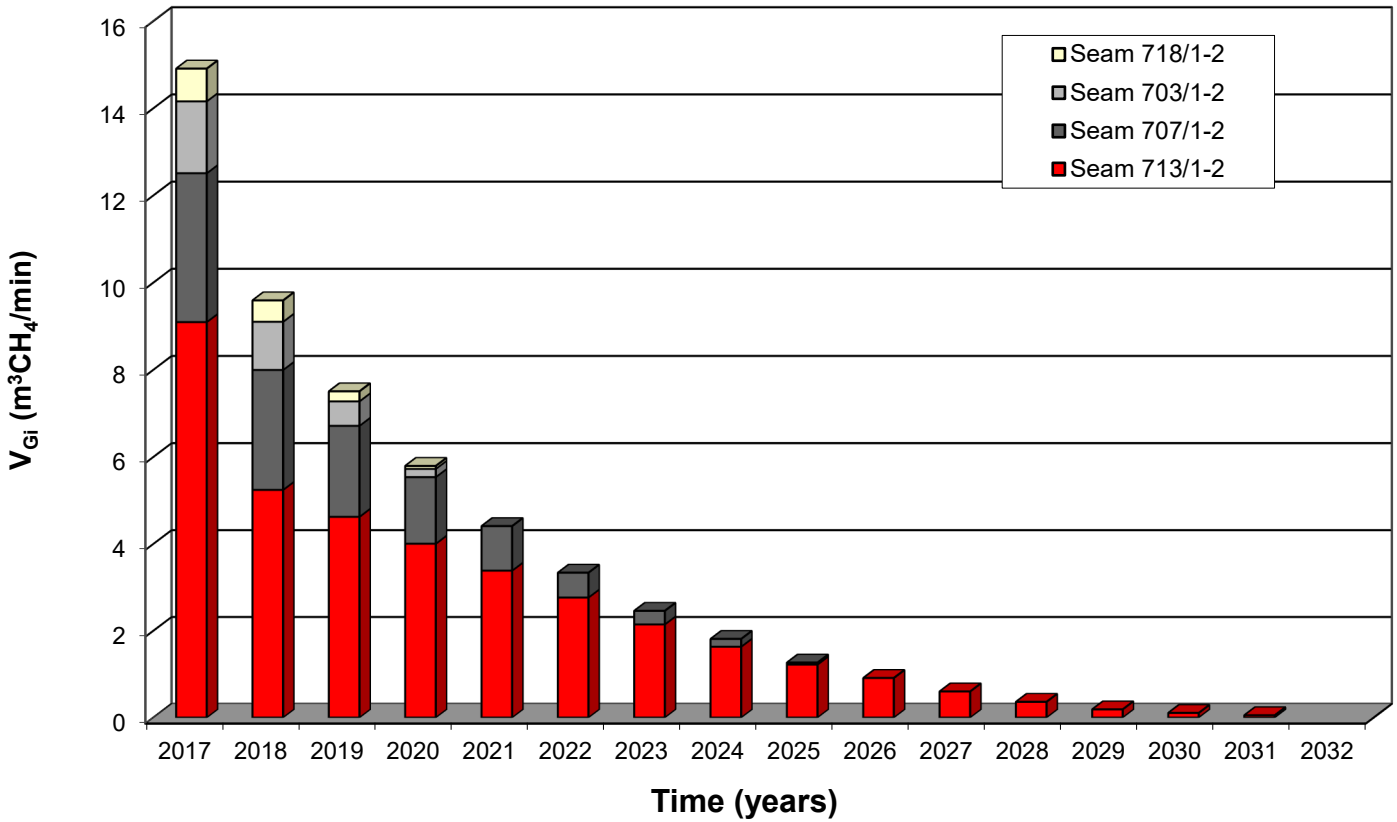
A suitable and validated models to assess the greenhouse gas emissions from closed mines with or without flooding to the surface was provided.





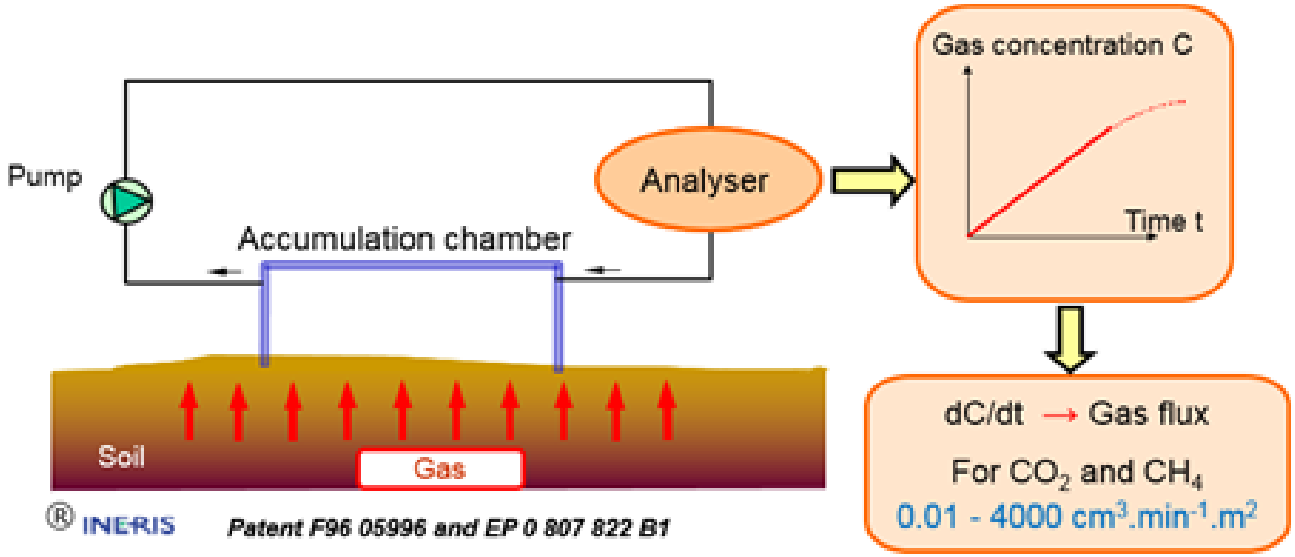
MERIDA Project

Forecasted methane emission into goafs of Anna coal mine seams, 2017-2032



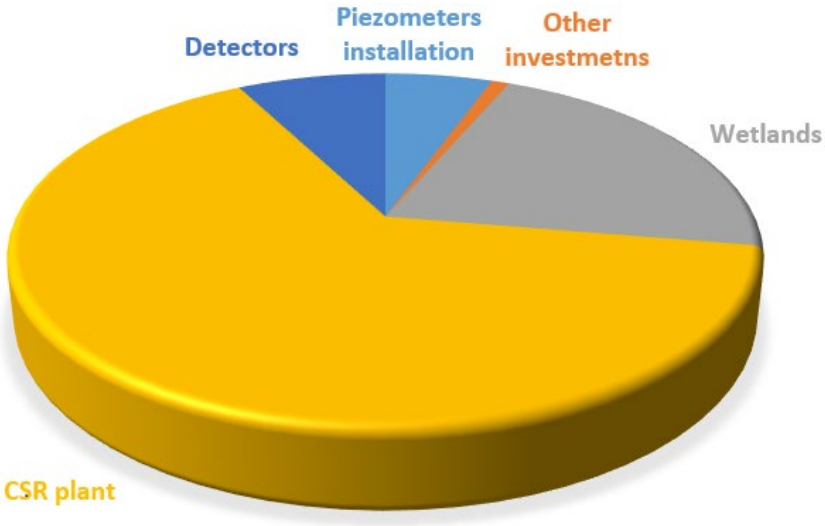
MERIDA Project

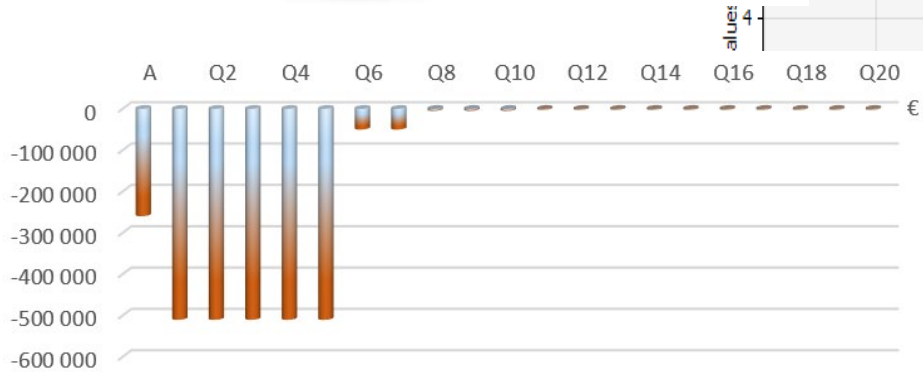
A reference guide was also provided on soil gas monitoring in coal mining regions, giving guidance, warnings and recommendations.

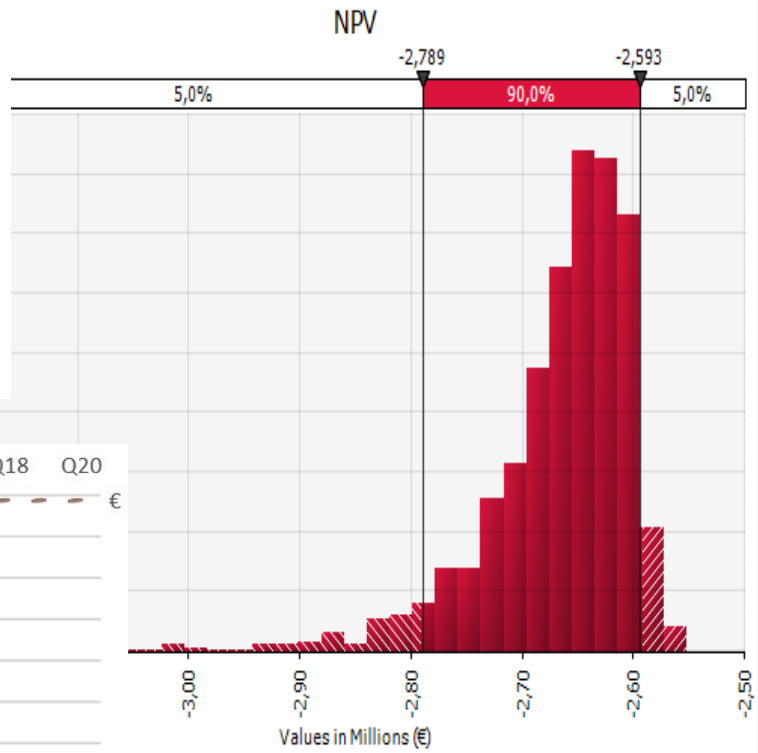


MERIDA Project

Cost analisis and financial provisions required for closure and post-closure periods were also provided







	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

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POTENTIALS Project

It focuses on taking advantage of the joint potential of end-of-life coal mines and coal-fired power plants to stimulate new economic activities and develop jobs in Coal Regions in Transition.

It identifies and assess opportunities by means of a prospective analysis, enabling to develop business models that rely on renewable energy, on the circular economy or scale energy storage, guaranteeing a sustainable and combined use of assets and resources.

ACTIONS	DEFINITION
A1_VIRTUAL	Virtual power plant
A2_H2	Green hydrogen plant
A3_ECOPARK	Eco-industrial park
A4_TOURIST	Cultural heritage and sports/recreations areas using green energy
A5_PANELS	Floating PV panels at flooded open-pit coal mine
A6_PHS	Pumped hydroelectric storage (PHS) at former open-pit coal mines
A7_FISHES	Fisheries in flooded open-pit coal mines
A8_C/O_CGT	Combined-cycle gas turbine (CCGT) power plant powered by natural gas
A9_MINEGAS	Mine gas utilization for gas-powered CHP power units
A10_SMR	Small modular reactors (SMRs)
A11_BIOFUE	Biofuels combustion energy plant
A12_SALT	Molten salt plant
A13_PUMP	Hydropumping open-pit
A14_APV	Agrophotovoltaics (APV) at former open-pit coal mine areas

CRITERIA	DEFINITION
C1 EnerSec	Energy security
C2 Greenin	Renewable resources (greening)
C3 Cost	Low investment barriers
C4 Benef	Benefits
C5 RegDev	Regional development
C6 Envirom	Environment
C7 Job	Job creation

POLICY	DEFINITION
Climate	No net emissions of greenhouse gases by 2050
Growth	Economic growth decoupled from resource use
People	No person and no place left behind

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POTENTIALS Project

Using MULTIPOL program (Multicriteria and policy), first, the scoring of actions with respect to criteria from 0 to 20 is made. Second, matrix values corresponding to policy evaluation with respect to the criteria are assigned. As this concerns the set of criteria weights, the row sum must always equal 100.

	C1 EnerSec	C2 Greenin	C3 Cost	C4 Benef	C5 RegDev	C6 Environ	C7 Job
A1_VIRTUAL	10	20	8	10	10	15	3
A2_H2	15	20	0	5	20	20	5
A3_ECOPARK	10	15	10	5	15	15	20
A4_TOURIST	5	5	10	5	20	20	5
A5_PANELS	15	20	10	15	10	15	10
A6_PHS	10	20	7	15	15	15	10
A7_FISHES	5	5	12	10	10	10	15
A8_C/O_CGT	20	10	13	10	5	5	10
A9_MINEGAS	1	0	15	15	3	15	2
A10_SMR	20	3	5	10	15	18	10
A11_BIOFUE	20	15	15	10	10	15	10
A12_SALT	18	20	16	10	13	15	5
A13_PUMP	20	10	0	20	10	20	10
A14_APV	15	20	0	15	10	15	8

	Sum	C1 EnerSec	C2 Greenin	C3 Cost	C4 Benef	C5 RegDev	C6 Environ	C7 Job
Climate	100	40	20	30	0	0	10	0
Growth	100	20	10	25	10	10	5	20
People	100	15	0	15	0	20	10	40

POTENTIALS Project

Management decisions should be based on a prospective analysis of business models.

Evaluation of actions with respect to policies

ACTIONS	POLICIES			Moy.	Ec. Ty	Number
	P1: Climate	P2: Growth	P3: People			
Virtual power plant	13,3	9,4	7,4	10	2,5	4
Green hydrogen plant	16,4	10,5	10,9	12,6	2,7	8
Eco-industrial park	12,5	12,9	15,9	13,8	1,5	12
Cultural heritage and sports/recreation areas using green energy	10	8	9,2	9,1	0,8	3
Floating PV panels at flooded open-pit coal mines.	13,5	10,2	8,5	10,8	2,1	6
Pumped hydroelectric storage (PHS) at former open-pit coal mines	17,2	11,5	9,6	12,8	3,2	9
Fisheries in flooded open-pit coal mines	5,2	7,6	8	6,9	1,2	2
Combined Cycle Gas Turbines (CCGT) plant. Open Cycle Gas Turbines (OCGT)	10,8	11	9,7	10,5	0,6	5
Mine gas utilization for gas-powered CHP power units	6,4	6,4	5,3	6	0,5	1
Small modular reactors (SMRs)	14,2	11,7	15,1	13,7	1,4	11
Biofuels processing energy plant	15	13,2	12,4	13,5	1,1	10
Molten salt plant	18,1	13,8	10,9	14,2	3	13
Agrophotovoltaics (APV) at former open-pit coal mine areas	15,3	11,4	10,1	12,3	2,2	7

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GreenJOBS Project

GreenJOBS focuses on repurposing end-of-life underground coal mines by deploying emerging renewable energy and circular economy technologies to promote sustainable local economic growth and maximise the number of green, quality jobs.

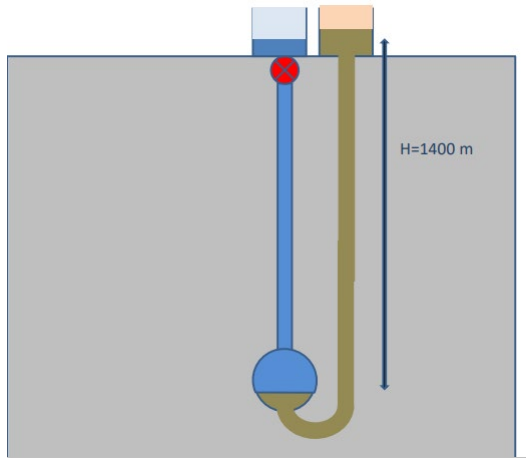
Five competitive advantages of underground coal mines will be leveraged:

(1) Mine water for geothermal and green hydrogen.
(2) Connections to the grid that can be adapted to inject the electricity produced.
(3) Large waste heap areas for installing photovoltaic/wind.
(4) Deep infrastructure suitable for unconventional pumped hydro storage using dense fluids.
(5) Fine coal waste for recycling into dense fluids, soil substitutes for restoration and rare earths.

GreenJOBS Project

GreenJOBS will provide mining companies with two innovative business plans:

1. A Virtual Power Plant where the energy produced will be sold to the grid or used to power electro-intensive industries or companies with constant energy consumption located close to mines, such as aluminium factories or green data centres.
2. A Green Hydrogen Plant where renewable hydrogen will be produced by electrolysis of mine water and electricity from renewable sources.



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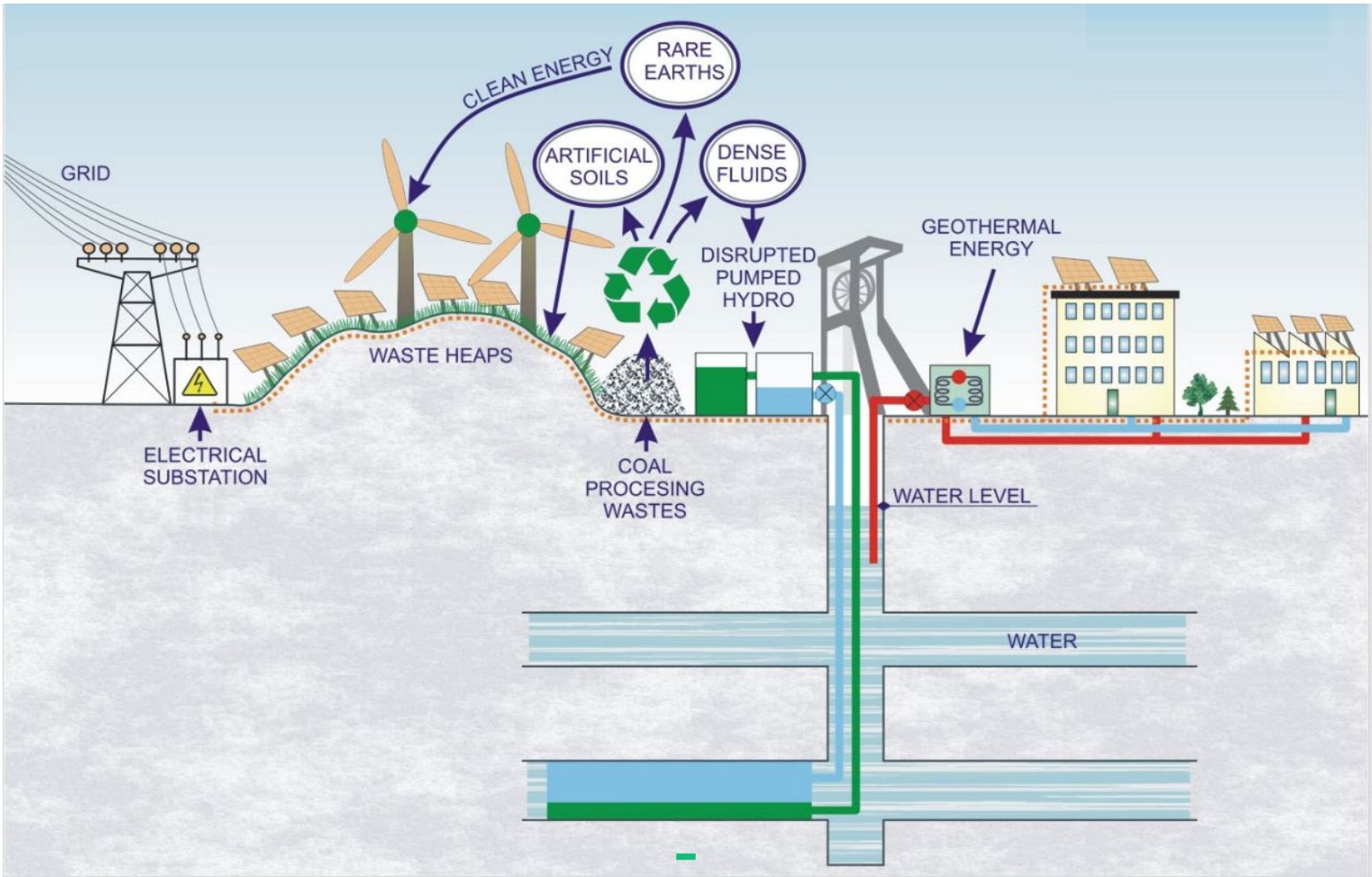
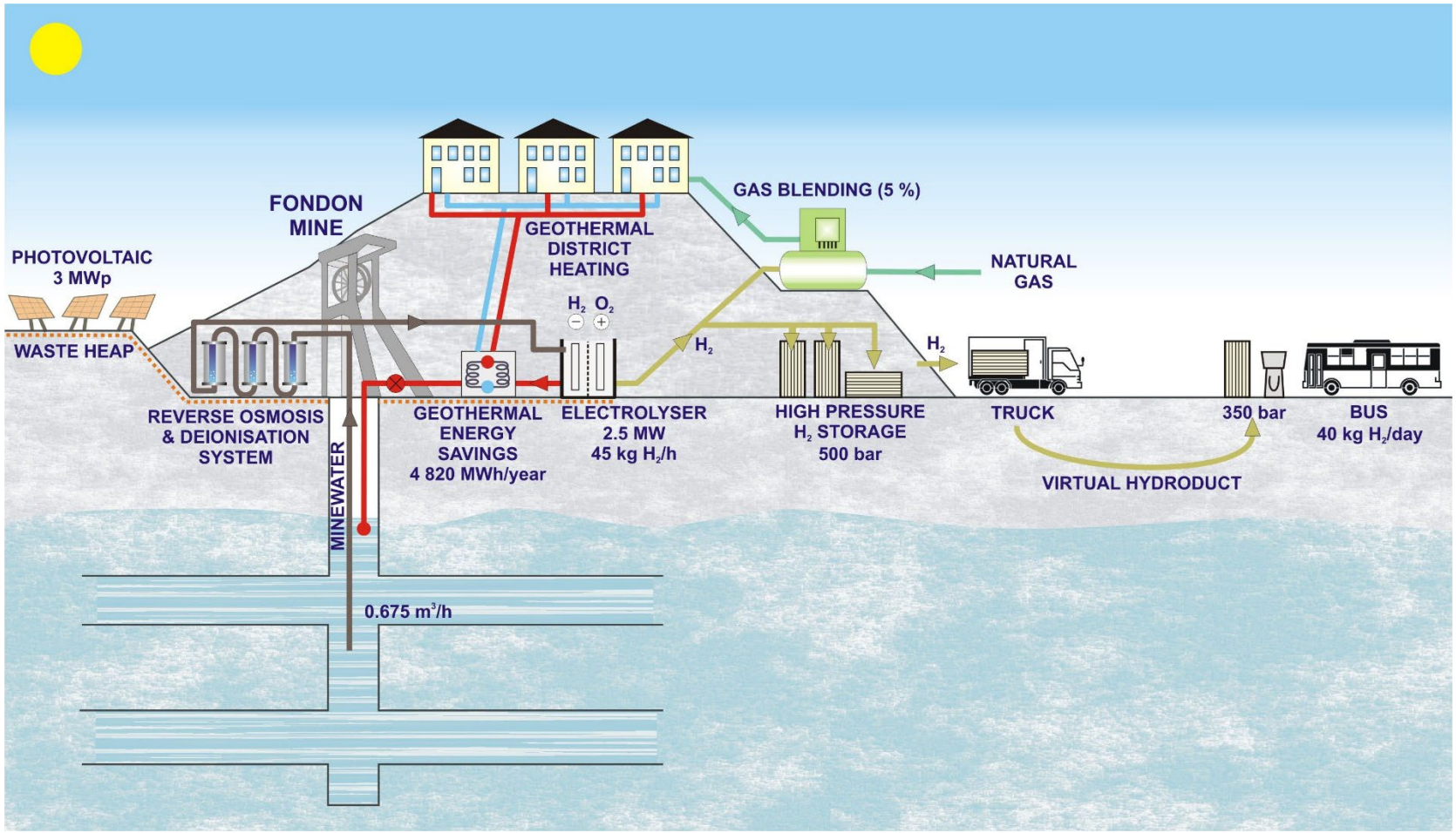
Business model 1: Virtual Power Plant where energy is sold to the grid.

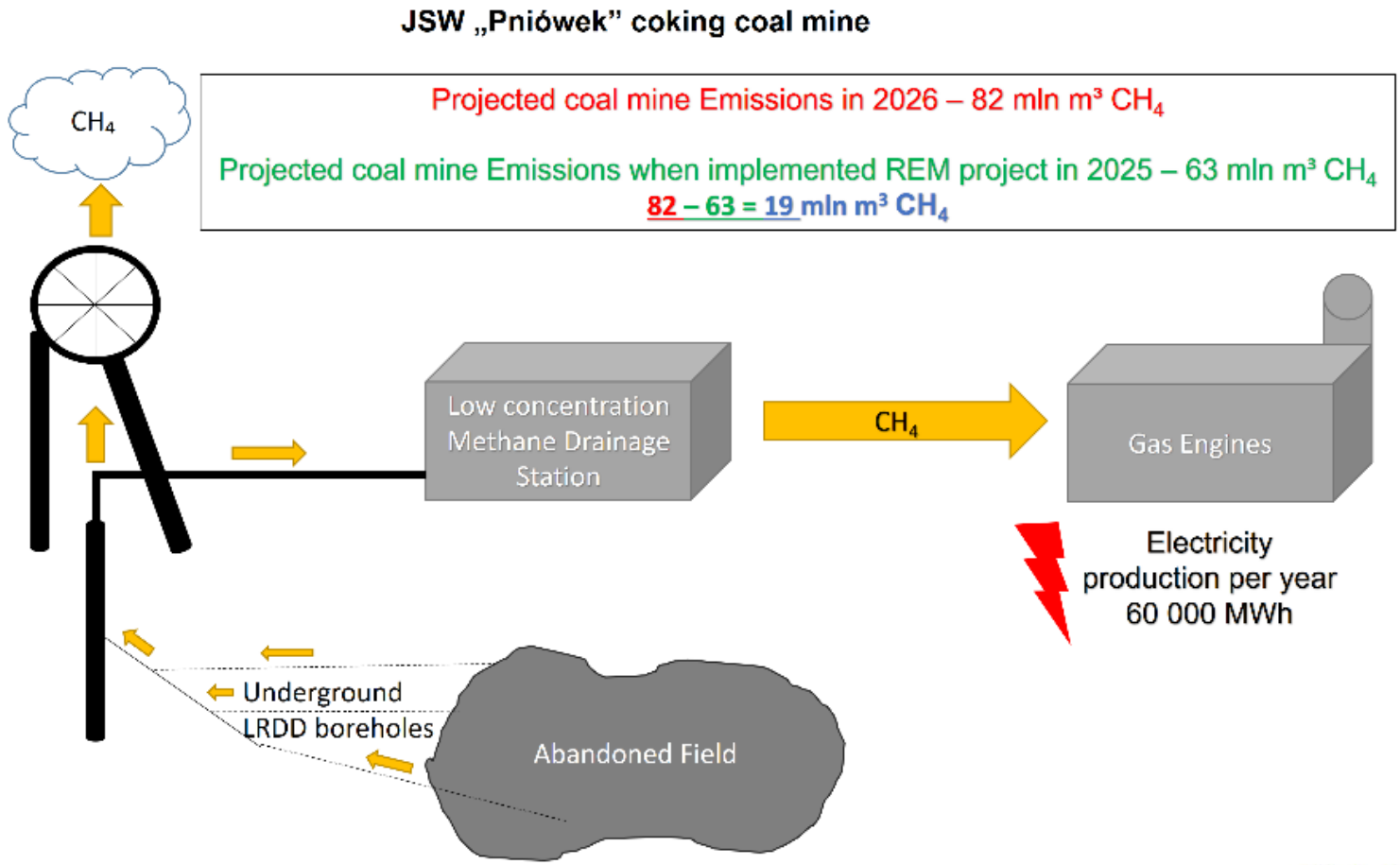


Business model 2: Green hydrogen plant.



And a "Big Ticket" project to come: REM

Reduction of methane emissions from post mining goafs to minimise their inflow into VAM.



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Thank you for your attention!

HR EXCELLENCE IN RESEARCH

Research Fund for Coal & Steel