Technical, principle-based guidelines for designing and implementing a programme for efficient, safe and environmentally conscious mine closure in Albania and Serbia

Alicja Krzemień

Aleksander Wrana

Aleksander Frejowski

HR EXCELLENCE IN RESEARCH

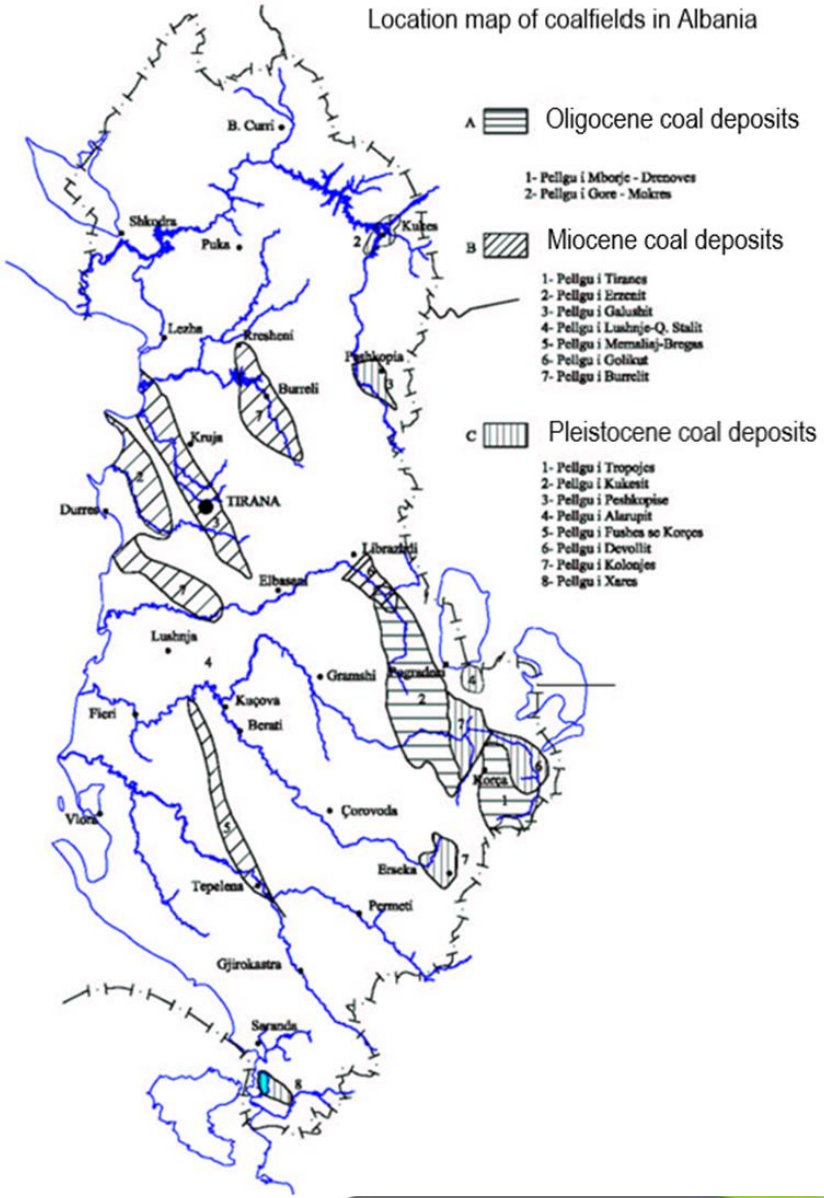
Analysis of selected aspects of underground coal mine closure in Albania and Serbia

This study analyses the below-listed problems related to mine closure. It identifies specific actions allowing to address them in the particular circumstances governing on the ground in the two beneficiary states:

- Management and remediation of groundwater and surface water drainage systems;
- Prevention of air pollution from fugitive gases such as methane, carbon dioxide, and others;
- Extinguishing and preventing underground coal fires or those that occur in waste dumps;
- Monitoring of subsidence of mined lands and prevention of other ground surface movement; and
- Monitoring and remediation of chemical pollutants that may leach from mine waste dumps.

GIG Research Institute

Brief description of the current situation of coal mining in Albania

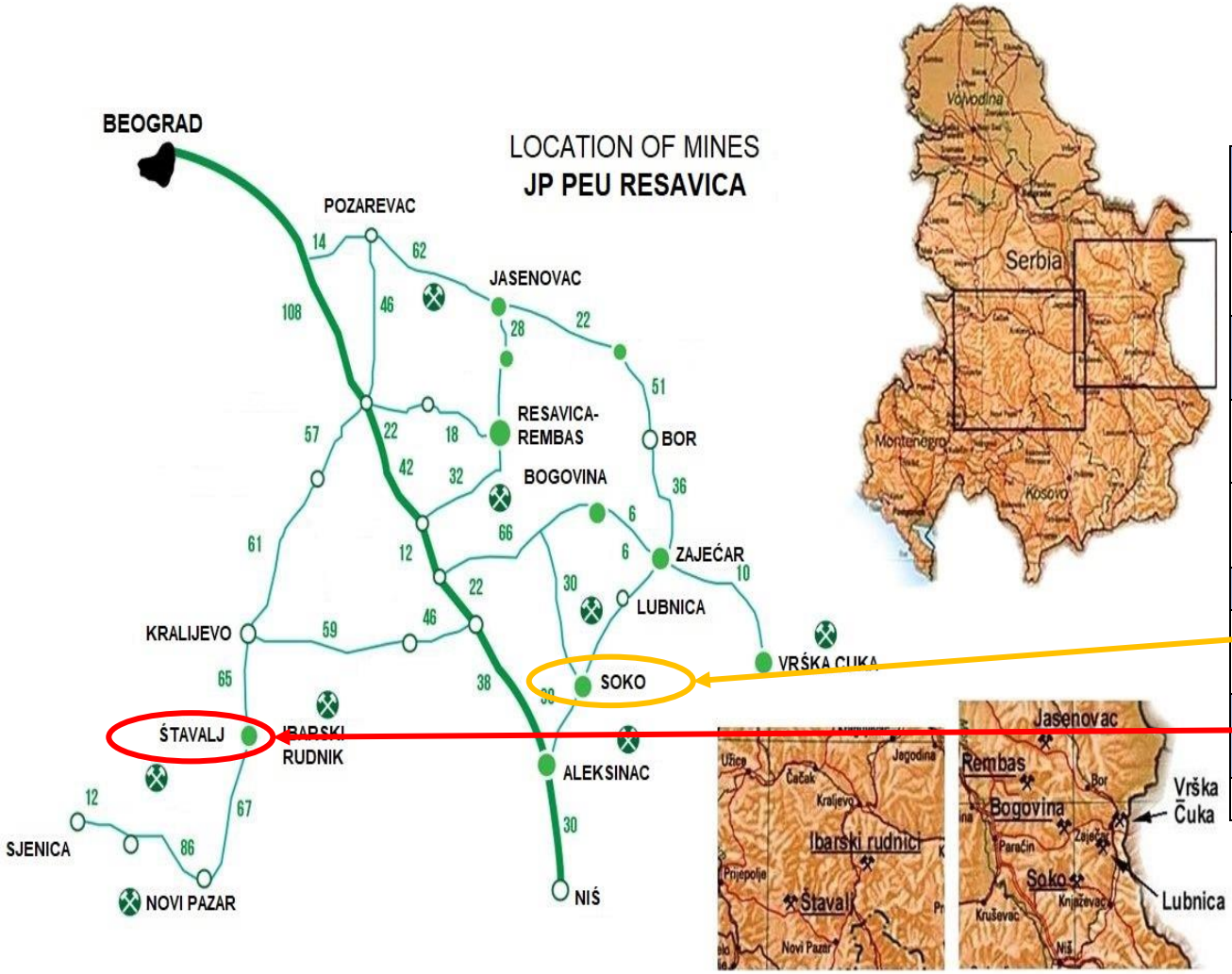


No	Name of Deposit Start	Start of exploitation	Government Order for closing coal mines	No. of closure project	Production, t	Geological reserves remained, t
1	Valias	1978	139 dt.20.03.1995	2978 / 2001	3,515,178	49,186,000
2	Mëzez	1968	824 dt.04.12.1996	2978 / 2001	1,435,320	1,426,000
3	Mushqeta	1968	550 dt.26.08.1996	2978 / 2001	2,300,000	5,365,000
4	Kërrabë	1938	101 dt.02.03.2001	2748 / 2000	1,658,270	8,100,000
5	Priska 2	1980	550 dt.26.08.1996	2978 / 2001	374,057	2,682,000
6	Priskë	1980	101 dt.02.03.2001	2978 / 2001	no data	2,460,000
7	Gërdec	1978	550 dt.26.08.1996	2978 / 2001	293,200	297,000
8	Manëz	1967	232 dt.15.05.1995	2978 / 2001	1,317,00	1,281,000
9	Mborje-Drenovë	1930	349 dt.07.07.2000	2978 / 2001	1,100,000	3,698,000
10	Selcë	1984	233 dt.15.05.1995	2978 / 2001	253,563	125,000
11	Babjen	1984	233 dt.15.05.1995	2871 / 2003	75,236	478,562
12	Krosnisht	1978	500 dt.13.08.1998	2682 / 1999	1,342,174	496,000
13	Qenckë	1978	349 dt.07.07.2000	2682 / 1999	23,000	69,750
14	Bezhan	1972	233 dt.15.05.1995	2978 / 2001	1,068,519	7,714,000
15	Alarup	1959	500 dt.13.08.1998	2978 / 2001	no data	1,600,000
16	Pretushë	1968	233 dt.15.05.1995	2809 / 2002	909,300	2,885,500
17	Dardhas	1972	349 dt.07.07.2000	2978 / 2001	1,076,100	6,087,000
18	Vërdovë	1978	349 dt.07.07.2000	2978 / 2001	900,000	2,300,000
19	Potgozhan	1985	233 dt.15.05.1995	2978 / 2001	105,000	10,869,700
20	Homezh	1986	233 dt.15.05.1995	2978 / 2001	1,377,951	8,174,500
21	Memaliaj 1 & 2	1916	268 dt.08.06.1999	2978 / 2001	10,126,170	8,200,000
22	Memaliaj 3	1980	29 dt.15.01.1996	2978 / 2001	no data	6,500,000
Total					**29,250,038**	**129,995,012**

GIG Research Institute

Fact finding mission – December 2022

Brief description of the current situation of coal mining in Serbia



Mine	Balance reserves per category, t				Off-balance reserves, t	Type of coal
	A	B	C_1	A+B+C_1		
RA "Vrška Čuka"	25,687	626,383	1,624,608	2,276,678	350,000	Hard coal
RKU "Ibarski rudnici"	none	928,154	283,434	1,211,588	1,326,580	
RMU "Rembas"	710,275	2,187,052	4,531,823	7,429,150	581,590	Brown coal
RMU "Bogovina"	none	1,647,267	676,248	2,323,515	1,652,058	
RMU "Soko"	245,642	13,529,675	37,160,407	50,935,724	2,997,725	
RMU "Jasenovac"	none	176,744	none	176,744	25,960	
RMU "Štavalj"	1,477,710	99,326,316	84,197,469	185,001,495	7,423,342	
RL "Lubnica"	660,239	8,859,215	506,079	10,025,533	4,565,562	Lignite

GIG Research Institute

Brief description of the current situation of coal mining in Serbia

Mine		Type of coal	Depth	Shafts	Drifts	Methane hazard	Production per worker, t/ 2017
RMU "Bogovina"		brown coal	240 m	Yes	Yes	registered appearance	38.2
RA "Vrška Čuka"		anthracite	up to 270 m	Yes	Yes	methane hazard	29.9
RKU "Ibarski rudnici"	Jarando	hard coal	150 - 470 m	No	Yes	methane hazard	135.0
	Tadenje		up to 100 m	No	Yes	non-methane	
RMU "Jasenovac"		brown coal	220 m	No	Yes	non-methane	125.1
RMU "Rembas"	Strmosten	brown coal	480 m	No	Yes	registered appearance	142.1
	Jelovac		160 - 200 m	No	Yes		
	Senjski rudnik		350 m	Yes	Yes		
RMU "Soko"		brown coal	450 m	Yes	Yes	methane hazard	141.1
RL "Lubnica"		lignite	200 m	No	Yes	registered appearance	147.9
RMU "Štavalj"		brown coal	280 m	No	Yes	non-methane	180.3

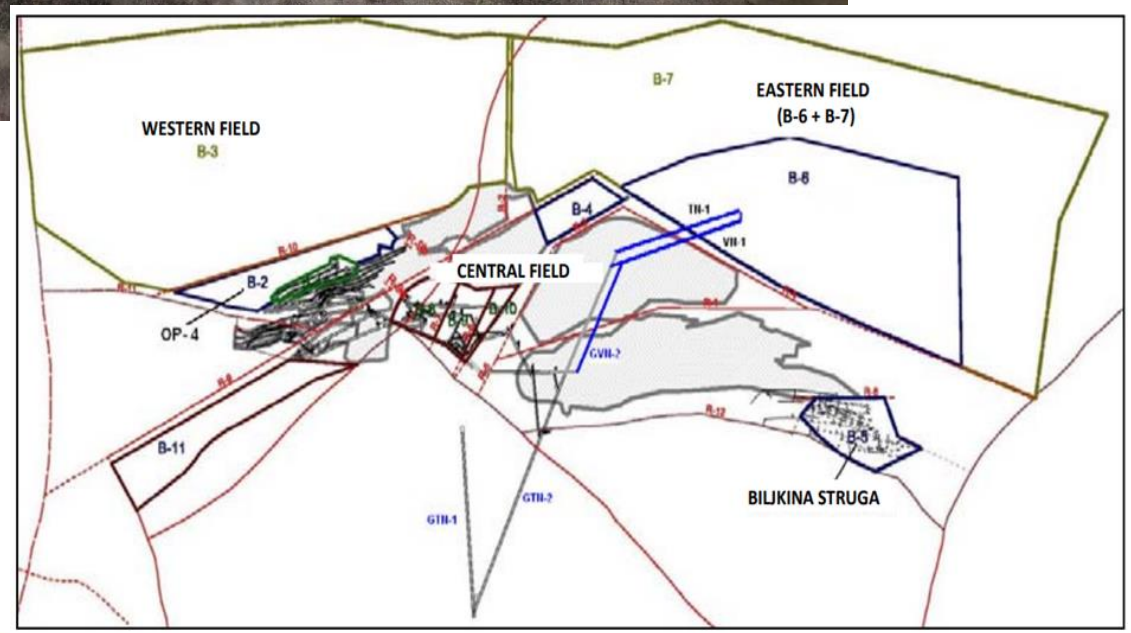
Mine		Index of spontaneous combustion Sz[a], °C/min	Group of spontaneous combustion
RMU "Bogovina"		80-120	III, IV, V
RA "Vrška Čuka"		not self-ignition	no tendency
RKU "Ibarski rudnici"	Jarando	69-98	I, II, III, IV
	Tadenje	no tendency	no tendency
RMU "Jasenovac"		80-100	III, IV
RMU "Rembas"	Strmosten	110-120	IV, V
	Jelovac	70-110	I, II, III, IV, V
	Senjski rudnik	118-140	IV, V
RMU "Soko"		115-188	IV, V
RL "Lubnica"		80	I, II, III
RMU "Štavalj"		103-111	IV, V

Mine		Dust explosives, g/m³	Dust self-ignition, °C
RMU "Bogovina"		225	250
RA "Vrška Čuka"		non-explosive	not self-ignition
RKU "Ibarski rudnici"	Jarando	70-100	630-700
	Tadenje	270	no data
RMU "Jasenovac"		225	260
RMU "Rembas"	Strmosten	180	280-290
	Jelovac	230	300
	Senjski rudnik	200	260-290
RMU "Soko"		230	250-350
RL "Lubnica"		100	215-235
RMU "Štavalj"		no data	220-280

GIG Research Institute

Fact finding mission – December 2022

Рударски институт д.о.о.
Београд



What can be done to improve underground coal mining in Serbia?

It is necessary to:

- introduce new modern equipment for the construction of pit rooms, excavation and transport and raise the level of production (especially in RMU "Soko,,, RMU "Štavalj,,, , RMU "Rembas,, (Strmosten), and RL "Lubnica,,),
- conduct technical and organizational changes (change of structure, and reduce the number of employed non-production workers in the company to the optimal number),
- begin work on the construction of a new mine,
- and start a program of planned closure of mines whose coal reserves are about to be exhausted.

IDENTIFICATION OF THE PROBLEMS RELATED TO MINE CLOSURE

Closure procedures will commence following decision of proper authorities (Company Management and Ministry of Mining and Energy). Issues related to closure of the mines are as follows:

- Legal and financial issues;
- Physical closure issues;
- Environmental issues and
- Social mitigation issues.

Physical closure of the mine starts with development of technical documentation regarding:

- Disassembly and recovery of underground equipment, including steel support;
- Isolation of all mine accesses – backfilling of shafts and construction of concrete slabs on shafts entries and construction of isolation dams on drifts entries;
- Demolition of surface facilities;
- Rehabilitation and reclamation of mine industrial estate.

HOW CAN THE INFRASTRUCTURE/RESOURCES OF THE ACTIVE MINES IN SERBIA AND THE CLOSED MINES IN ALBANIA BE BETTER UTILISED?

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.

EU Research Fund for Coal and Steel (RFCS)

Grant Agreement No 101034042

www.potentialsproject.eu

Green JOBS
RFCS RESEARCH PROJECT

Leveraging the competitive advantages of end-of-life underground coal mines to maximise the creation of green and quality jobs.

EU Research Fund for Coal and Steel (RFCS)
Grant Agreement No 101057789

www.greenjobsproject.eu

GIG Research Institute

POTENTIALS Project

POTENTIALS
RFCS AM 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

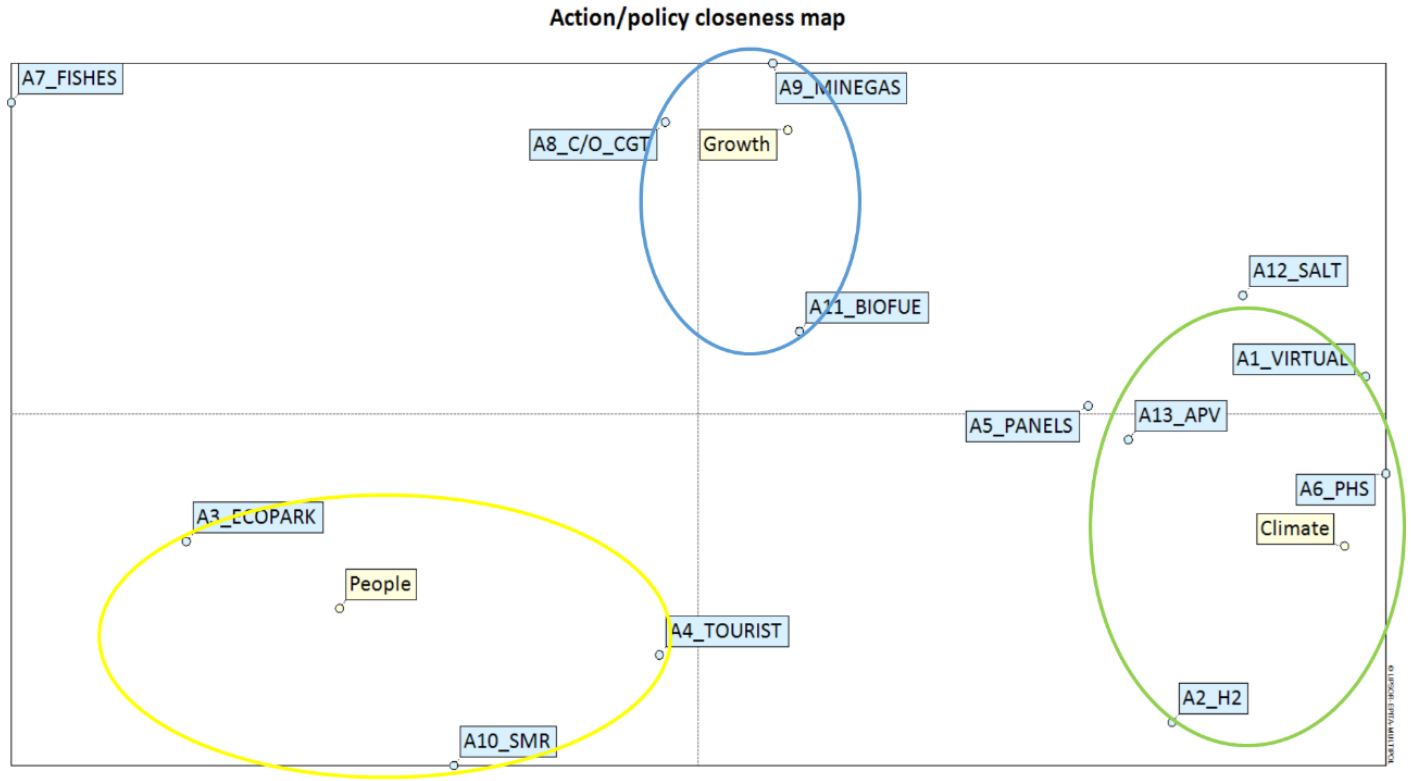
CRITERIA	DEFINITION
C1 EnerSec	Energy security
C2 Greenin	Renewable resources (greening)
C3 Cost	Low investment barriers
C4 Benef	Benefits
C5 RegDev	Regional development
C6 Envirom	Environment
C7 Job	Job creation

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

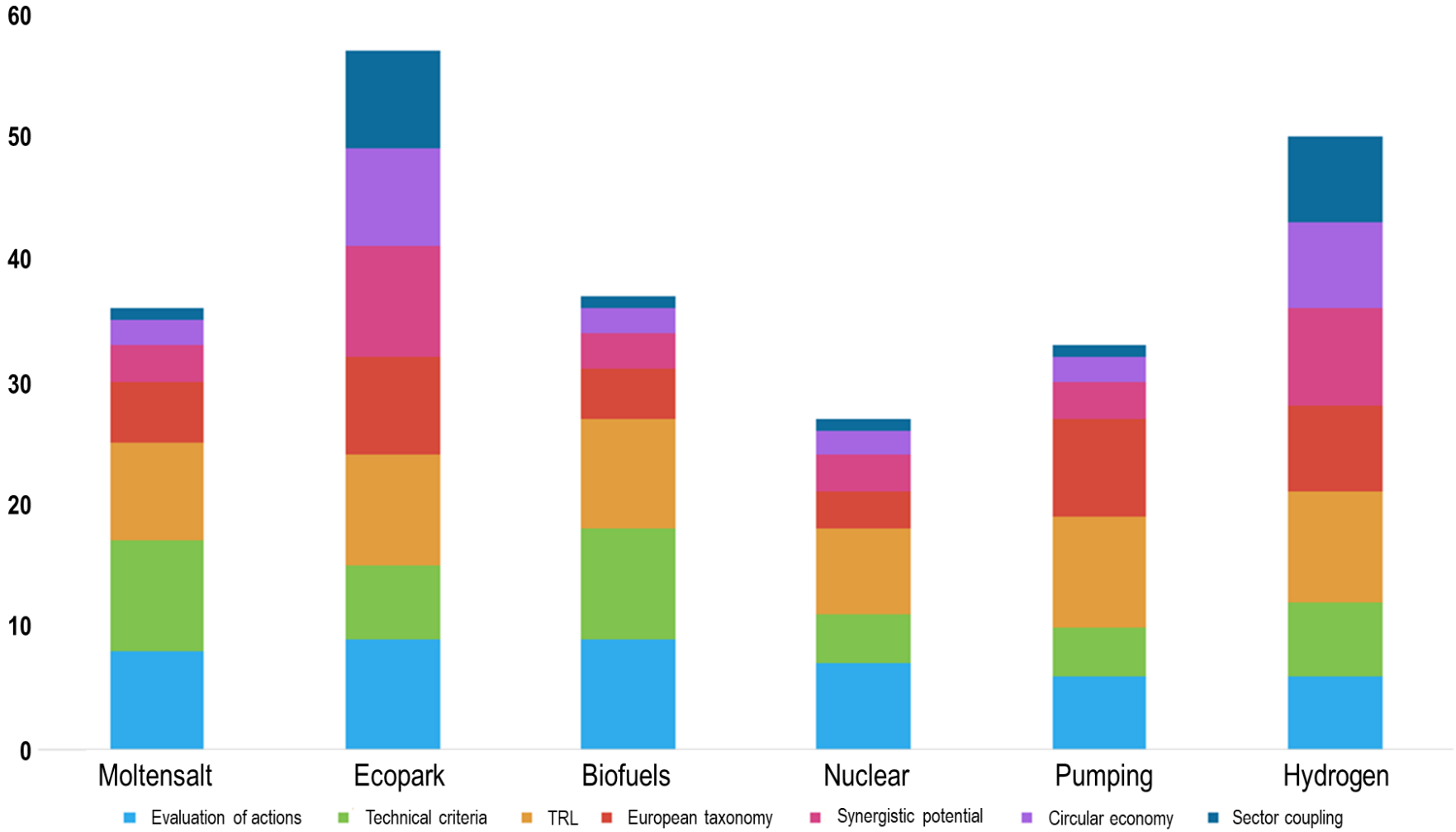
GIG Research Institute

Evaluation of actions related to policies, and actions/policies closeness map

ACTIONS	POLICIES			Mean	Standard deviation
	P1: Climate	P2: Growth	P3: People		
1 : A1_VIRTUAL	13,3	9,4	7,4	10	2,5
2 : A2_H2	16,4	10,5	10,9	12,6	2,7
3 : A3_ECOPARK	12,5	12,9	15,9	13,8	1,5
4 : A4_TOURIST	10	8	9,2	9,1	0,8
5 : A5_PANELS	12,5	9,6	8,5	10,2	1,7
6 : A6_PHS	17,2	11,5	9,6	12,8	3,2
7 : A7_FISHES	5,6	7,8	8,1	7,2	1,1
8 : A8_C/O_CGT	10,8	11	9,7	10,5	0,6
9 : A9_MINEGAS	6,4	6,4	5,3	6	0,5
10 : A10_SMR	14,2	11,7	15,1	13,7	1,4
11 : A11_BIOFUE	15	13,2	12,4	13,5	1,1
12 : A12_SALT	18,1	13,8	10,9	14,2	3
13 : A13_APV	15,3	11,4	10,1	12,3	2,2

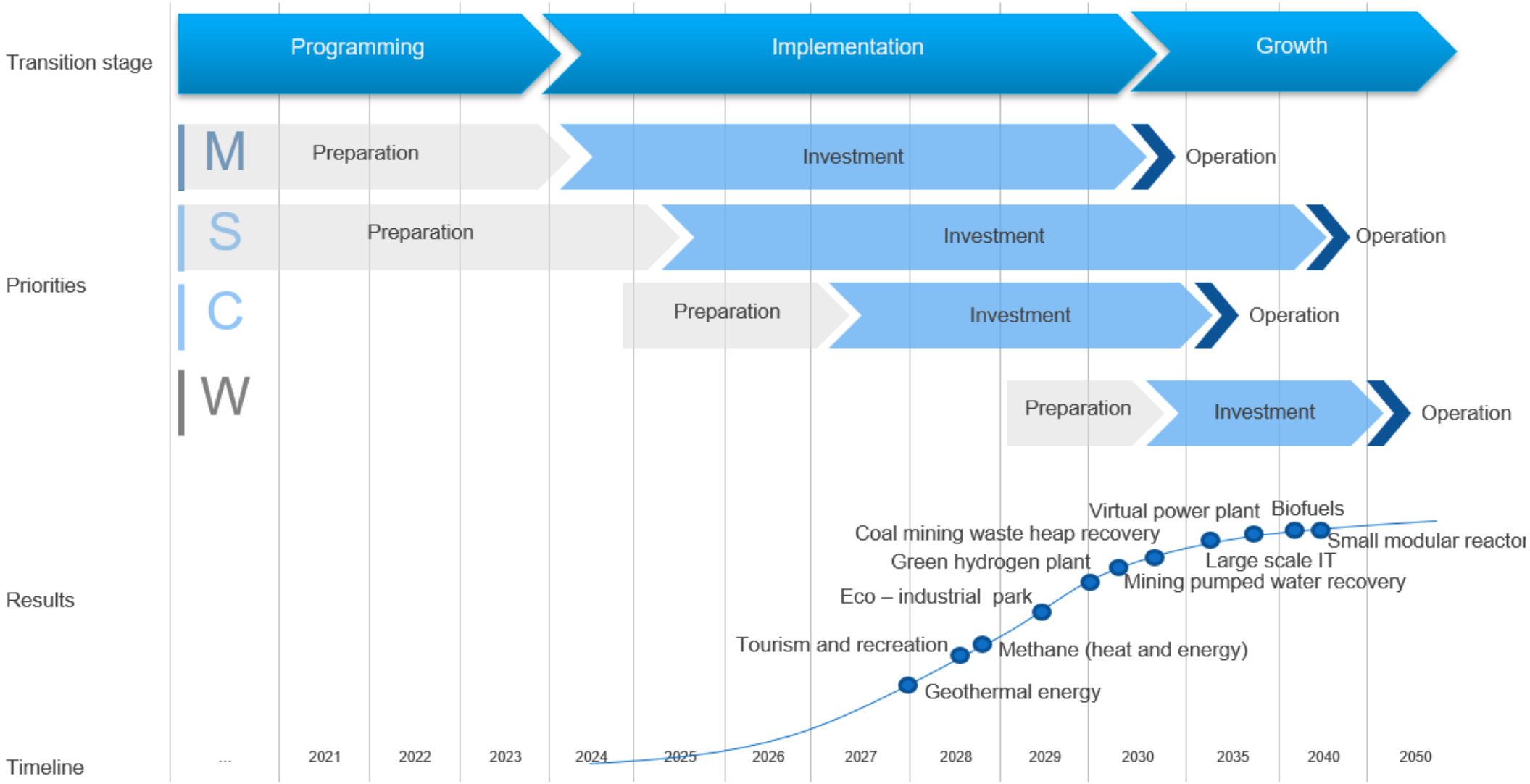


Business models choices justification



Road map for update of Just Transition Plan (JTP) for Silesian Voivodship, Poland

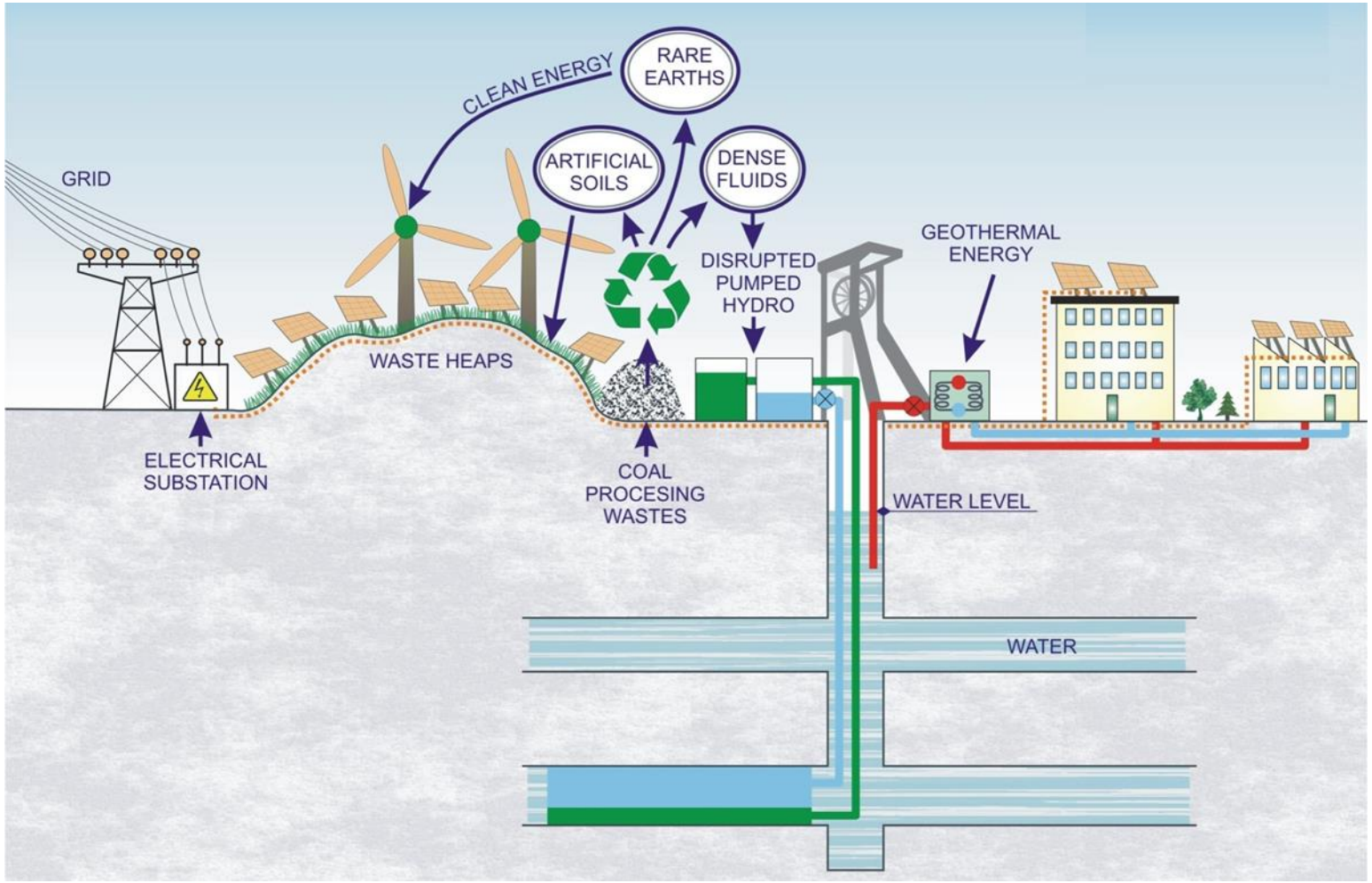
POTENTIALS
RFCS AM PROJECT



GIG Research Institute

GreenJOBS Project

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



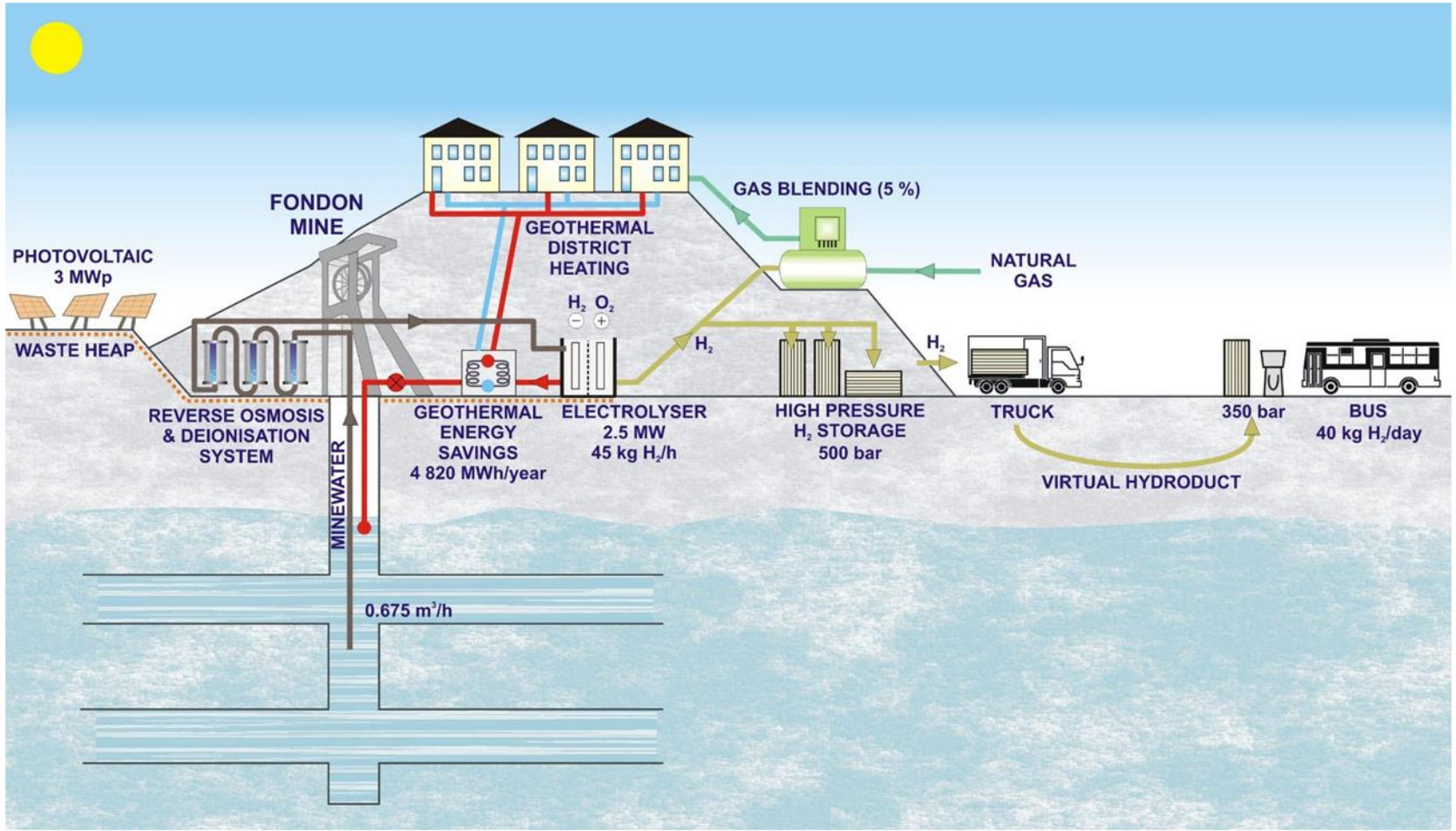
Photovoltaic deployment parameters

Photovoltaic parameters for a 50 ha waste heap area with an installed capacity of 1 MW/ha, a capacity factor of 30% and 50% of energy to be stored.

Parameter	Value
Installed capacity	50 MW
Estimated investment (plant life: 25 years)	20 M€
Capacity factor (% time of use of the installation per year)	30%
Daily production (50 MW x 30% x 24 hours)	360 MWh
Fraction of energy to be sold, the rest to be stored	50%
Daytime energy sold (360 MWh x 50%)	180 MWh
Daytime energy price	40 €/MWh
Daytime revenue (180 MWh x 40 €/MWh)	7,200 €
Photovoltaic annual revenues (7,200 € x 365)	2.63 M€
Annual expenditure (staff, maintenance and overheads)	0.50 M€

GreenJOBS Project

Business model 2: Green hydrogen plant.



EXAMPLES OF POST MINING LAND USAGE

Sun park Vistonia – 16MW of solar energy

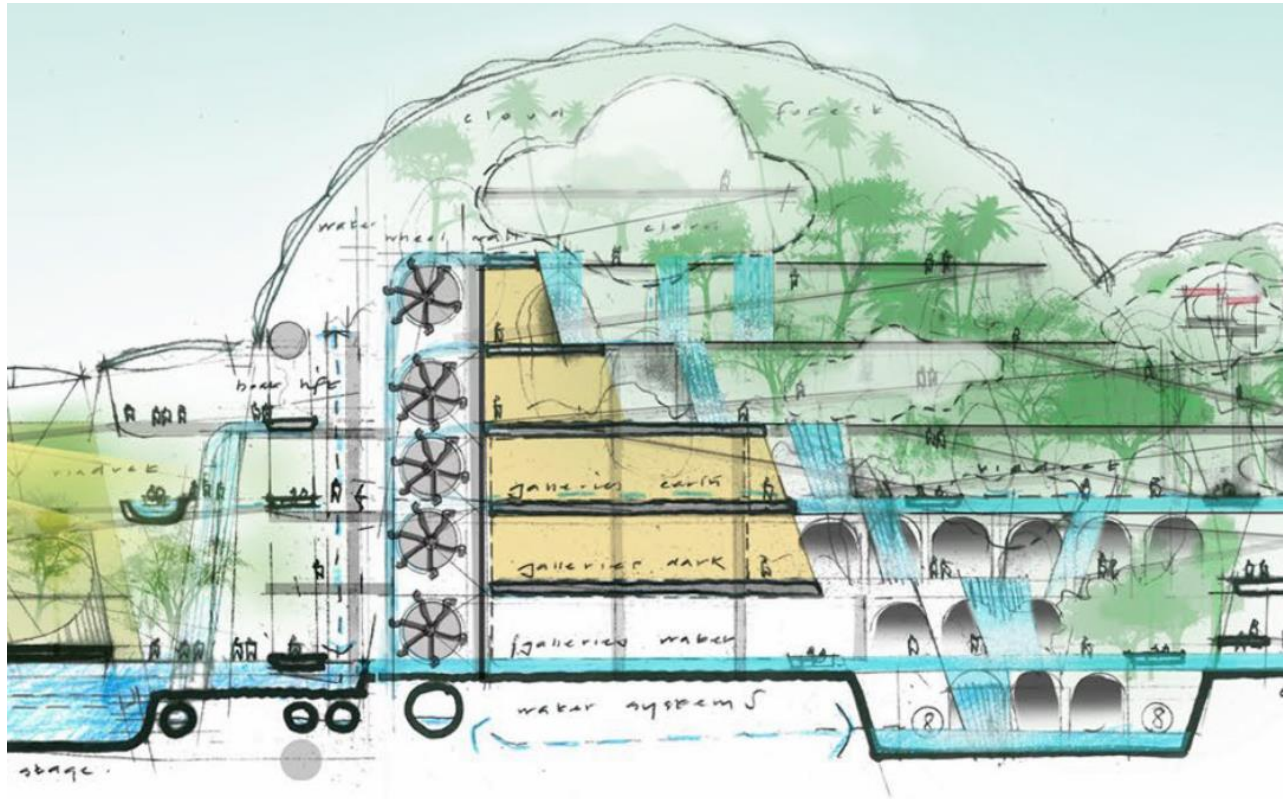
EXAMPLES OF POST MINING LAND USAGE

Sun park in Lorraine (France)

GIG Research Institute

EXAMPLES OF POST MINING LAND USAGE

Wind farm in Forth (Lanarkshire)



Project Eden

THANK YOU FOR ATTENTION

Prof. Alicja Krzemień
Department of Extraction Technologies,
Rockburst and Risk Assessment

Plac Gwarków 1
40-166 Katowice
Poland
phone: +48 32 259 2556
akrzemien@gig.eu

Mr. Aleksander Wrana
Department of Extraction Technologies,
Rockburst and Risk Assessment

Plac Gwarków 1
40-166 Katowice
Poland
phone: +48 32 259 2307
awrana@gig.eu

Mr. Aleksander Frejowski
Department of Extraction Technologies,
Rockburst and Risk Assessment

Plac Gwarków 1
40-166 Katowice
Poland
phone: +48 32 259 2848
afrejowski@gig.eu

GIG Research Institute