REPURPOSING OF COAL MINES AND COAL-FIRED POWER PLANTS IN LOW-CARBON ENERGY TRANSFORMATION PROCESS

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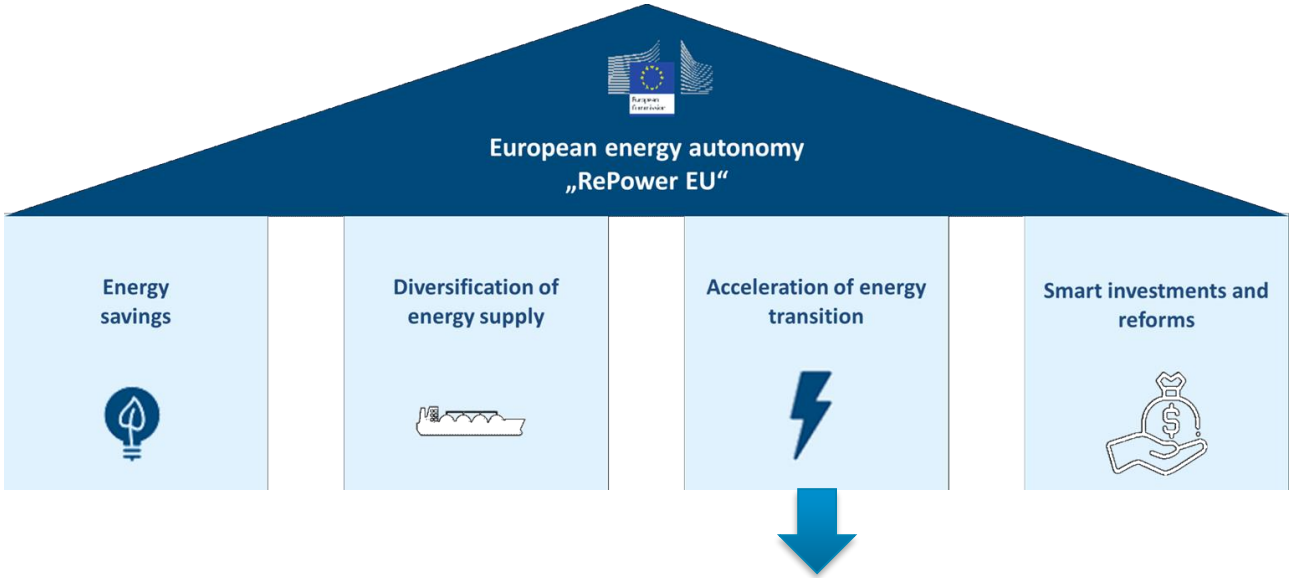
BRISBANE, AUSTRALIA

PRESENTATION LAYOUT

1. Introduction
2. Information on the coal mining and energy generation sector in the EU and its re-purposing potential
3. Planning and supporting transformation process – selected projects
4. Examples of the use of land after mines and power plants closed down
5. Conclusions
6. Acknowledgements

REPOWER EU: JOINT EUROPEAN ACTION FOR MORE AFFORDABLE, SECURE AND SUSTAINABLE ENERGY



Substituting fossil fuels and accelerating Europe's clean energy transition

- ✓ A massive speed-up and scale-up in renewable energy in power generation, industry, buildings and transport will accelerate our phasing out of Russian fossil fuels. It will also, over time, lower electricity prices and reduce fossil fuel imports.
- ✓ Boosting renewable energy
  - increasing the target in the Renewable Energy Directive to 45% by 2030, up from 40% in last proposal. This would bring the total renewable energy generation capacities to 1236 GW by 2030, in comparison to 1067 GW by 2030 envisaged under Fit for 55 for 2030.
  - Solar photovoltaics (PV) is one of the fastest technologies to roll out. The Commission sets the REPowerEU target of over 320 GW of solar photovoltaic newly installed by 2025, over twice today's level, and almost 600 GW by 2030.
- ✓ Accelerating hydrogen
- ✓ Scaling up biomethane

https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52022DC0108;
Erste Asset Management

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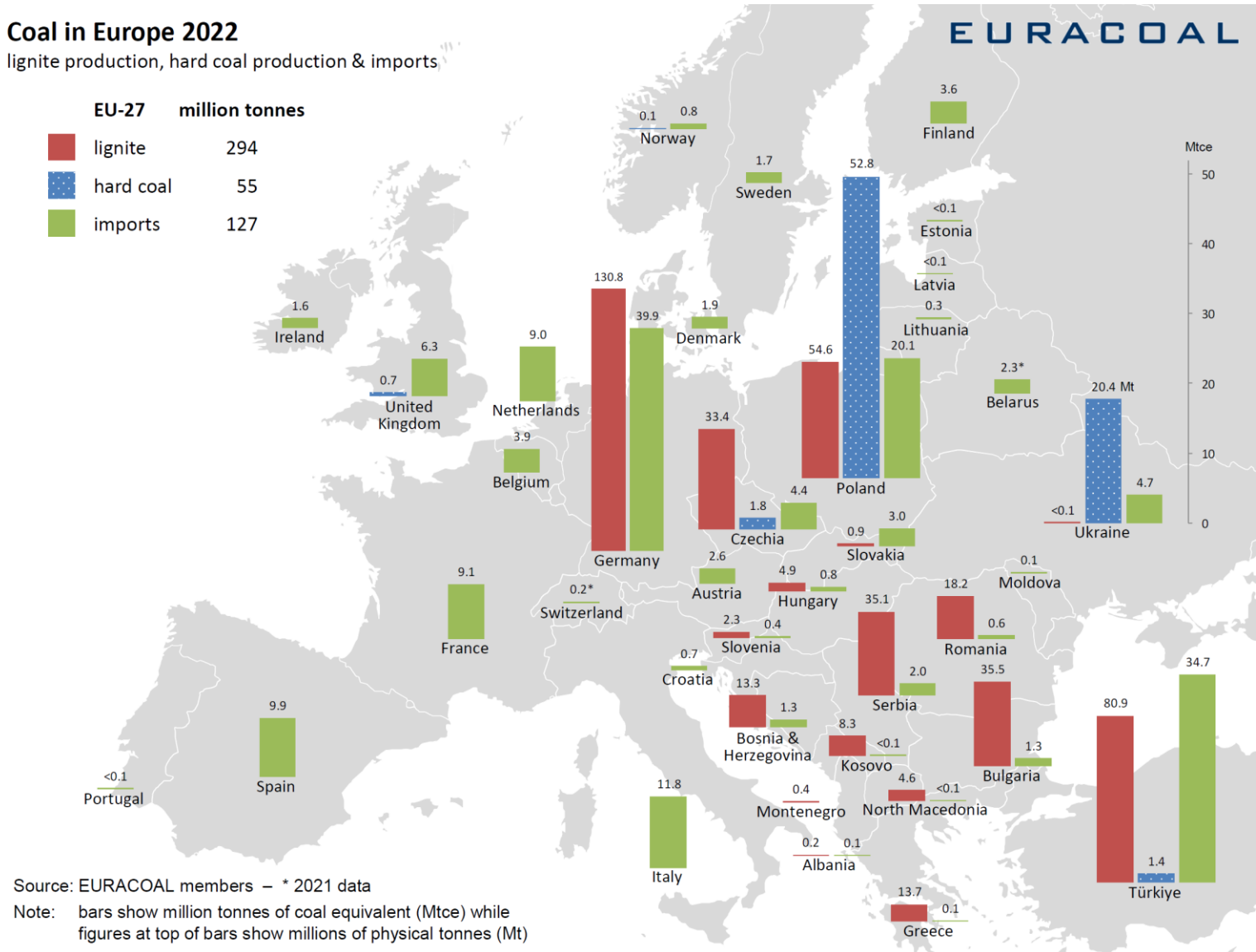
Basic information on the coal mining and energy generation sectors in the EU

COAL IN EUROPE 2022



Source: EURACOAL members – * 2021 data

Note: bars show million tonnes of coal equivalent (Mtce) while figures at top of bars show millions of physical tonnes (Mt)

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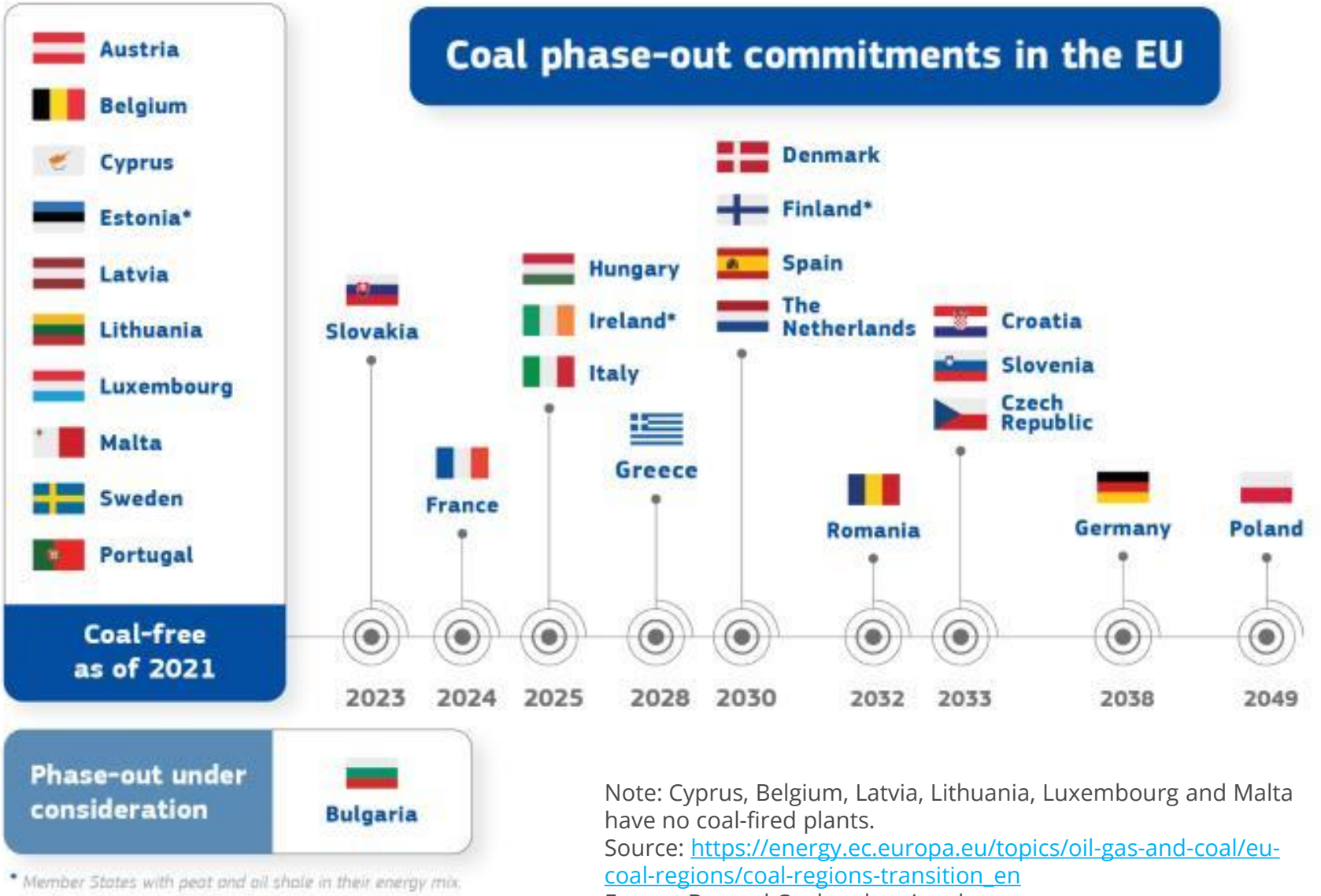
THE STATUS OF COAL PHASE-OUT IN THE EU



Note: Cyprus, Belgium, Latvia, Lithuania, Luxembourg and Malta have no coal-fired plants.
Source: https://energy.ec.europa.eu/topics/oil-gas-and-coal/eu-coal-regions/coal-regions-transition_en
Europe Beyond Coal and national sources

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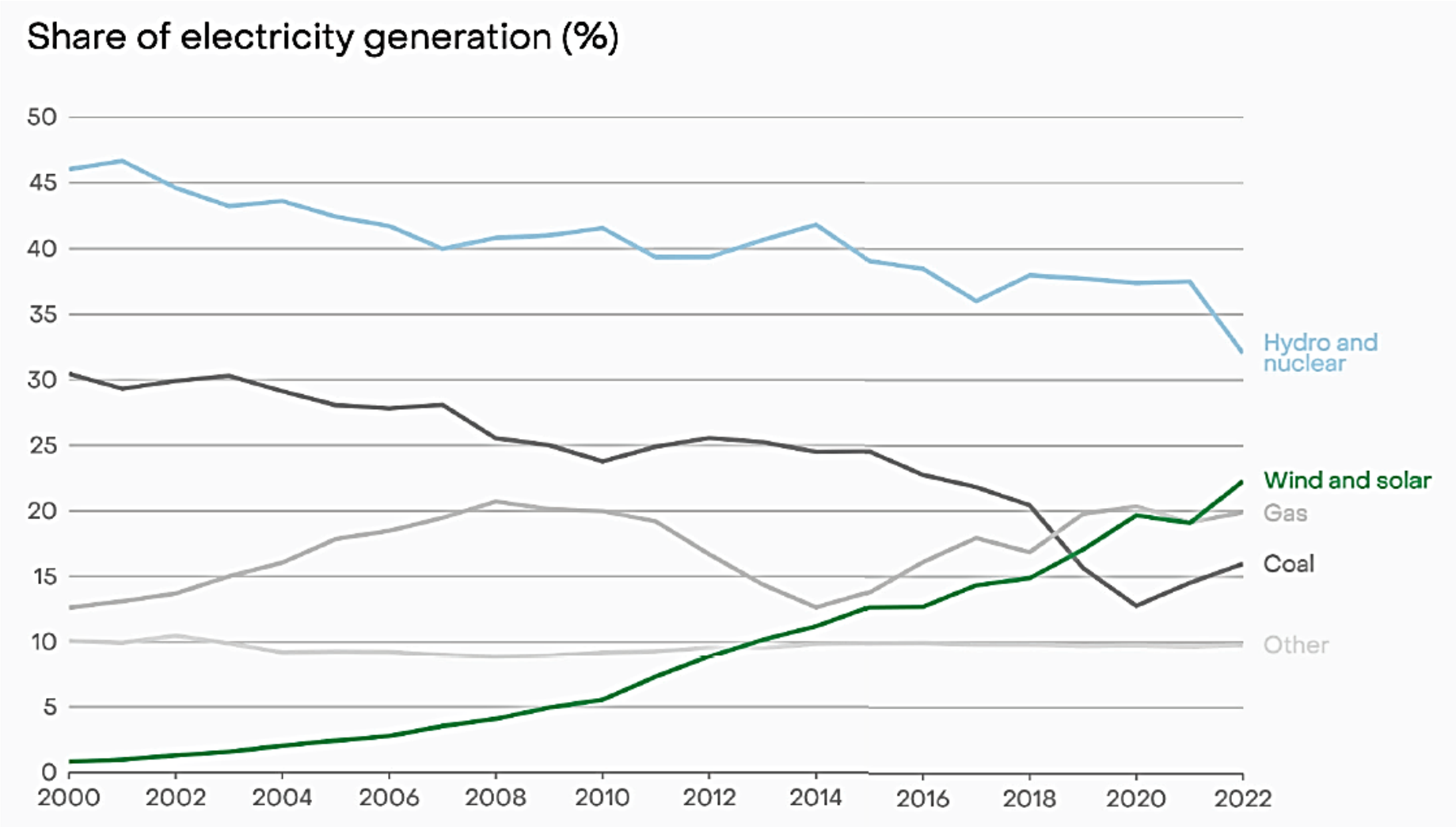
EU ELECTRICITY GENERATION BY SOURCE IN 2022



The European Electricity Review, Ember 2023

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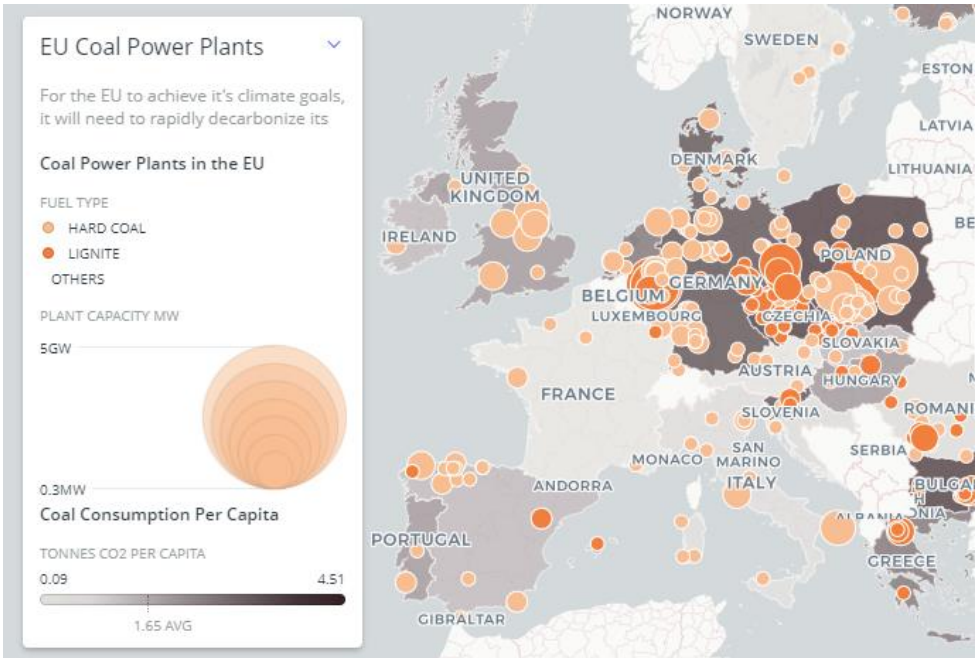
WHAT IS THE POTENTIAL FOR REPURPOSING OF COAL-FIRED POWER PLANTS ASSETS?

STATUS @ 27 APRIL 2023

		Under construction	Open				Retired or fuel switch	
			Total	Lignite	Hard Coal	Open but to be retire	Since Jan 2016	Since Jan 2005
Capacity MW	Europe	**647**	**145 696**	66 402	79 294	70 275	63 706	104 926
	EU + UK	**109**	**115 004**	46 540	68 464	70 075	63 706	104 704
Plants No.	Europe	**1**	**243**	98	145	101	84	147
	EU + UK	**1**	**196**	64	132	101	84	147
Units No.	Europe	**3**	**598**	292	306	215	210	446
	EU + UK	**1**	**487**	204	283	214	210	443



According to Europe Beyond Coal Database as of April 2023, capacity in Europe was 145,7 GW and 115 GW in UE.

Source: https://climateanalytics.org/briefings/eu-coal-phase-out/
Database - Europe Beyond Coal : Europe Beyond Coal (beyond-coal.eu)

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Planning and supporting transformation process – selected projects

RECPP
RE-PURPOSING COAL POWER PLANTS

POTENTIALS
RFCS AM PROJECT

Green JOBS
RFCS RESEARCH PROJECT

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POST-RETIREMENT / RE-PURPOSE OF COAL POWER PLANTS - OPTIONS

Retirement and Decommissioning. Decommissioning includes abatement, removal of regulated materials, structural demolition, remediation, and restoration of a site suitable for beneficial use. Decommissioning costs for a typical 500-MW coal-fired power plant range from $5 million to $15 million net of scrap. The schedule is typically 18 to 30 months.

As-Is Sale for Decommissioning and Redevelopment. This option results from the fact that these sites have significant redevelopment potential. Developers may be willing to assume the risk of decommissioning in exchange for a reduced purchase price.

Retrofit: Conversion to Natural Gas. Conversion from coal to natural gas can be the most economical solution. Fuel conversion project costs vary, depending on the length of the pipeline and the complexity of boiler and facility work. Costs range from $25 million to $75 million and typically take 12 to 18 months.

Replacement with New Generation. Replacement of aging coal-fired steam turbine generation with new gas turbines. Construction of new gas turbine plants ranges from one to three years and may be completed prior to closure of existing facilities.

It can be also possible to consider replacing a coal boiler with heat from high-temperature energy storage, e.g. solar energy (salts, minerals).

No Action. No decision to act on closed power plants.

Management is reluctant to act because of costs, risk, and the attitude that “we’re not in the real estate business.”

https://www.powermag.com/coal-power-plant-post-retirement-options/

RECPP
RE-PURPOSING COAL POWER PLANTS

This project has received funding from the Research Fund for Coal and Steel under grant agreement No 899512

RE-PURPOSING COAL POWER PLANTS DURING ENERGY TRANSITION (RECPP)

This European funded accompanying measure is about the re-purposing potential of coal-fired power plants thus opening perspectives for coal regions in transition beyond of the coal phase out.

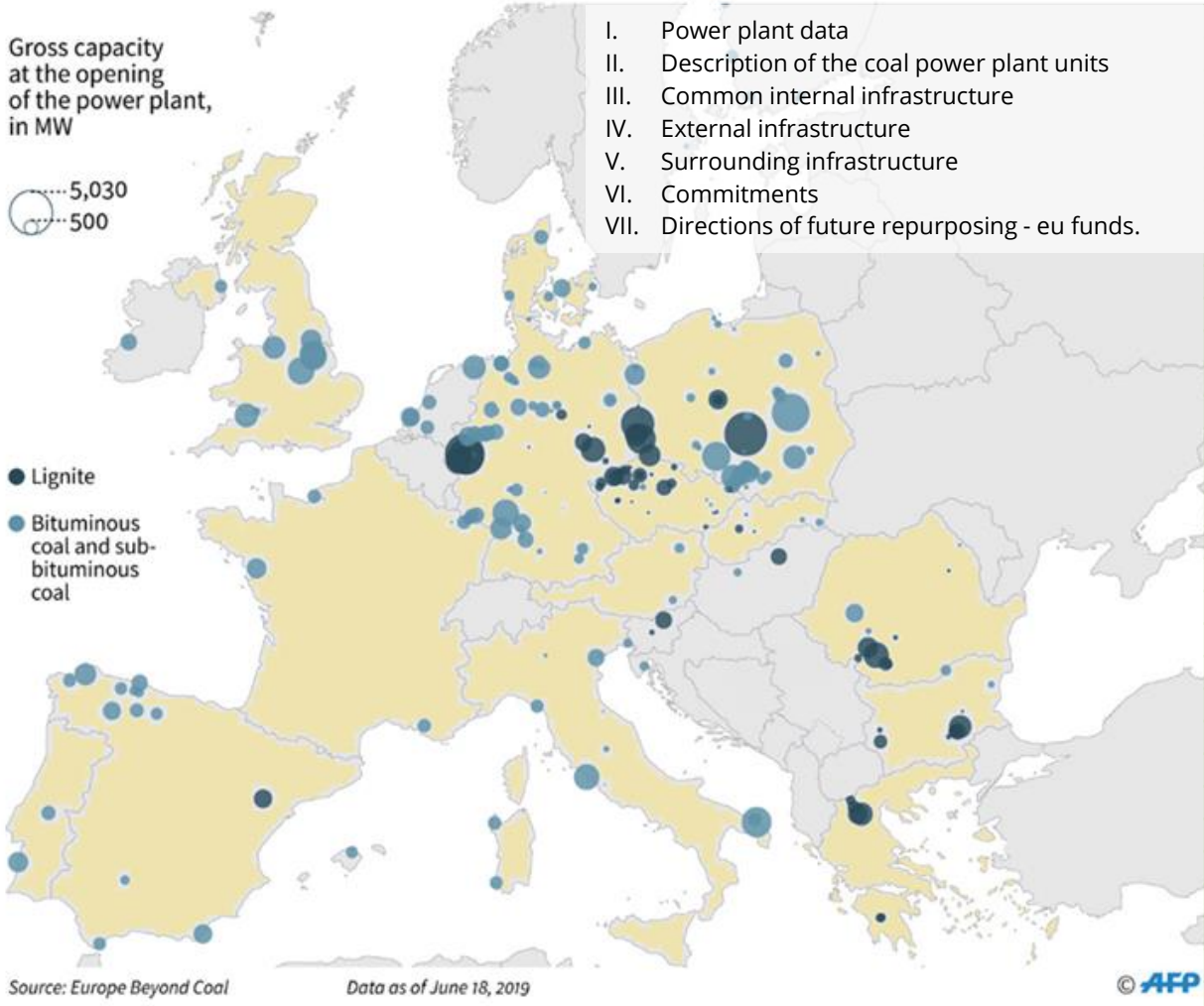
The general objective of RECPP project was to examine the challenges and opportunities related to the re-purposing potential of the coal-power plants and its infrastructure.

RECPP goal was to complement the activities undertaken under Coal Regions in Transition via an inventory of coal power plants in Europe and an indication of the possibilities of their successful reuse. For this purpose, mapping and assessment of locations and assets of operating and closed coal-fired power plants were performed. As the results the directions and exemplary implementation concepts were proposed.

Project financed by the RFCS.
Implemented in a consortium of 13 partners and 12 associated partners
Project implementation time: 01.07.2020 - 30.06.2022
Project coordinator: VGBE, Germany

https://www.recpp.eu

MAPPING POWER PLANTS AND THEIR INFRASTRUCTURE



I. Power plant data
II. Description of the coal power plant units
III. Common internal infrastructure
IV. External infrastructure
V. Surrounding infrastructure
VI. Commitments
VII. Directions of future repurposing - eu funds.

Country / Coded name					
Austria	AT-1	Germany	DE-11	Poland	PL-2
Austria	AT-2	Germany	DE-12	Poland	PL-4
Austria	AT-3	Germany	DE-13	Poland	PL-5
Bulgaria	BG-1	Germany	DE-14	Poland	PL-6
Czech Rep.	CZ-1	Germany	DE-15	Poland	PL-7
Czech Rep.	CZ-2	Germany	DE-16	Poland	PL-8
Czech Rep.	CZ-3	Germany	DE-17	Poland	PL-9
Czech Rep.	CZ-4	Germany	DE-18	Poland	PL-10
Czech Rep.	CZ-5	Germany	DE-19	Poland	PL-11
Czech Rep.	CZ-6	Germany	DE-20	Poland	PL-12
Czech Rep.	CZ-7	Germany	DE-21	Poland	PL-13
Denmark	DK-1	Germany	DE-22	Poland	PL-14
France	FR-4	Germany	DE-23	Poland	PL-15
France	FR-5	Germany	DE-24	Poland	PL-16
France	FR-6	Germany	DE-25	Poland	PL-17
France	FR-7	Germany	DE-26	Poland	PL-18
France	FR-8	Germany	DE-27	Poland	PL-19
France	FR-9	Germany	DE-28	Poland	PL-20
France	FR-10	Germany	DE-29	Poland	PL-21
France	FR-11	Germany	DE-30	Poland	PL-22
France	FR-12	Germany	DE-31	Poland	PL-23
Germany	DE-1	Germany	DE-32	Portugal	PT-1
Germany	DE-2	Greece	GR-1	Romania	RO-1
Germany	DE-3	Greece	GR-2	Romania	RO-2
Germany	DE-4	Greece	GR-3	Slovenia	SI-1
Germany	DE-5	Greece	GR-4	Spain	ES-1
Germany	DE-6	Greece	GR-5	UK	UK-1
Germany	DE-7	Italy	IT-1	UK	UK-2
Germany	DE-8	Italy	IT-2	UK	UK-3
Germany	DE-9	Poland	PL-1	UK	UK-4
Germany	DE-10				

RECPP has mapped **around 80%** of the capacity of EU coal-fired power plants.

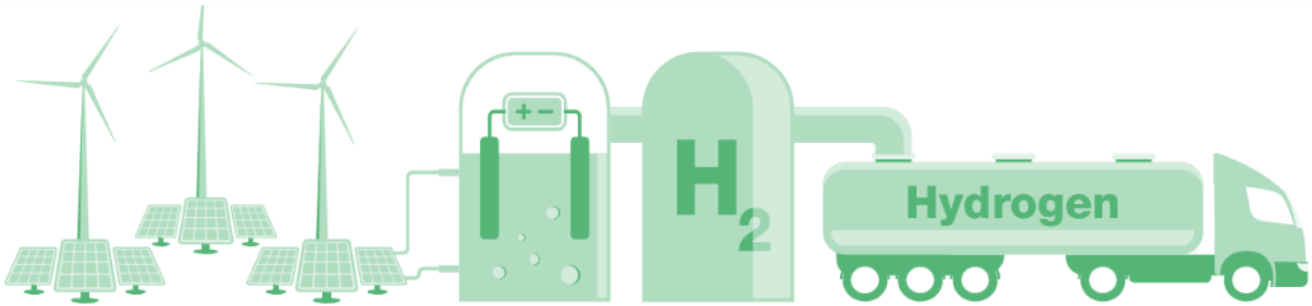
MAPPING POWER PLANTS AND THEIR INFRASTRUCTURE

This project has received funding from the Research Fund for Coal and Steel under grant agreement No 899512

DIRECTIONS OF FUTURE REPURPOSING - EU FUNDS

67.5% of respondents indicate that there are plans for future repurposing and among others include:

- hydrogen and energy storage/conversion technologies,
- green hydrogen production,
- hybrid power plant technology (renewable energy, storage technology, waste incineration plants, gas power plant),
- reconstruction of coal-fired boilers - reuse of energy infrastructure to connect new RES (wind farms and photovoltaic farms),
- thermal energy storage,
- use existing electricity connection and cooling water system.



POTENTIALS
RFCS AM PROJECT

Funded by the European Union

Research Fund for Coal & Steel

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

The POTENTIALS main goal was to identify and assess the opportunities (prospects) associated with exploiting the potential of decommissioned coal mines and connected coal-fired power plants to stimulate new economic activity and job creation, particularly for coal mining regions in transition

Project financed by the RFCS.
Implemented in a consortium of 6 partners from 4 countries
Project implementation time: 01.07.2021 - 30.06.2023
Project coordinator: GIG, Poland

PROJECT CONSORTIUM

GIG Instytut Badawczy — POLAND
Universidad de Oviedo — SPAIN
vgbe ENERGY IS US — GERMANY
Technische Hochschule Georg Agricola — GERMANY
CERTH Centre for Research & Technology Hellas — GREECE
hunosa — SPAIN

www.potentialsproject.eu

Funded by the European Union
Research Fund for Coal & Steel

MULTI-CRITERION ANALYSIS
EVALUATION OF ACTIONS AND MICRO-ACTIONS RELATED TO POLICIES EUROPEAN GREEN DEAL

Actions	Policies		
	Climate	Growth	People
Virtual power plant	13.3	9.4	7.4
Green hydrogen plant	16.4	10.5	10.9
Eco-industrial park	12.5	12.9	15.9
Tourism and Recreation	10	8	9.2
Floating PV panels (open-pit)	12.5	9.6	8.5
Hydroelectric plant (open-pit)	17.2	11.5	9.6
Fisheries (open-pit)	5.6	7.8	8.1
CGGT power plant	10.8	11	9.7
Methane (heat and energy)	6.4	6.4	5.3
Small modular reactors (SMRs)	14.2	11.7	15.1
Biofuels	15	13.2	12.4
Molten salt plant	18.1	13.8	10.9
Agrophotovoltaics	15.3	11.4	10.1

Micro-actions	Policies		
	Climate	Growth	People
Batteries	13.8	10.8	5.8
Waste heap recovery	5.8	6.3	7.1
Mine methane usage	8.5	7.8	7.8
Recovery of materials from mining water	7.5	6.2	6.4
Forest restoration (open-pit)	7.5	7.2	7.2
Large-scale IT infrastructure	4	6	2.8
Geothermal energy	19.6	14.5	12.4
Energy storage - gravitricity	12.2	8	7.6
Energy storage - dense fluids	18.5	10.8	8.8
Energy storage - mine shafts	18.2	10.5	9.3

* Results obtained based on experts' answers - the higher the value, the better the given action/micro-action was assessed concerining individual policies (climate, growth, people)

Co-funded by the European Union

Research Fund for Coal & Steel

POTENTIALS
RFCS AM PROJECT

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

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.

Project financed by the RFCS.
Implemented in a consortium of 8 partners from 4 countries
Project implementation time: 01.07.2022 - 31.12.2025
Project coordinator: Universidad de Oviedo, Spain

www.greenjobsproject.eu

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NEW BUSINESS MODELS FOR MINES IN THE PROCESS OF TRANSITION

LEVERAGING THE COMPETITIVE ADVANTAGES OF END-OF-LIFE UNDERGROUND COAL MINES TO MAXIMISE THE CREATION OF GREEN AND QUALITY JOBS

Research Fund for Coal & Steel

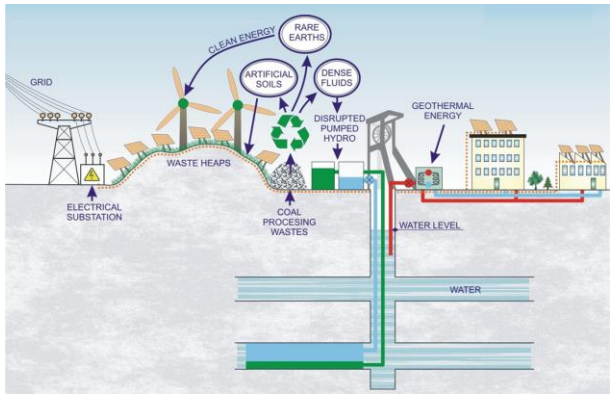
Green JOBS
RFCS RESEARCH PROJECT

Co-funded by the European Union

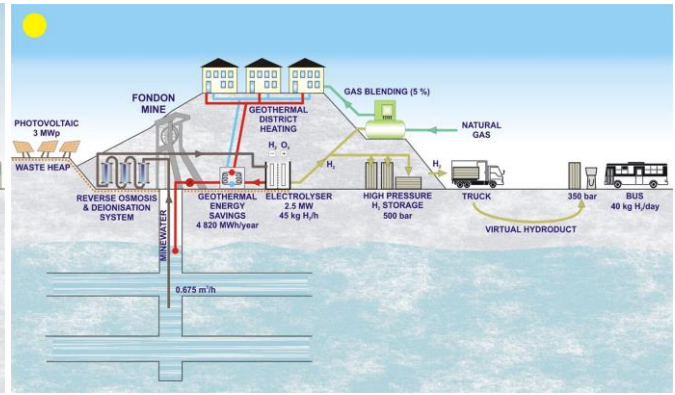
Bobrek-Piekary Coal Mine, **POLAND**

Premogovnik Velenje, **SLOVENIA**

Aller-Barredo-Figaredo, **SPAIN**



Virtual Power Plant where energy is sold to the grid



Green hydrogen plant

BUSINESS MODELS consider:

solar energy, wind energy, geothermal energy, artificial soils, unconventional pumping storage using dense fluids, rare earths recovery, hydrogen production by electrolisis

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Examples of the assets reuse after mines and power plants closed down

EXAMPLES OF THE USE OF LAND AFTER MINES AND POWER PLANTS CLOSED DOWN

MOVING AWAY FROM LIGNITE - CLOSING COAL-FIRED POWER PLANTS

- **Adamów power plant.** End of operation at the end of 2017.
- **Konin power plant.** Completion of electricity and heat production from lignite by the end of 2022.
- **Pątnów power plant.** Of the 6 power units, units 3, 4 and 6 are out of service. Completion of operation of the remaining 3 units is planned for the end of 2024**.**
- **Pątnów II Power Plant.** The unit is scheduled to be completed by the end of 2024.

Source: Paweł Woszczyk, Polish Power Plants Association

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EXAMPLES OF THE USE OF LAND AFTER MINES AND POWER PLANTS CLOSED DOWN

MOVING AWAY FROM LIGNITE - CLOSING COAL-FIRED POWER PLANTS

Adamów power plant, Gas-steam unit (BGP) class 600 MWe

Liquidation of Adamów Power Plant infrastructure

Adamów Power Plant

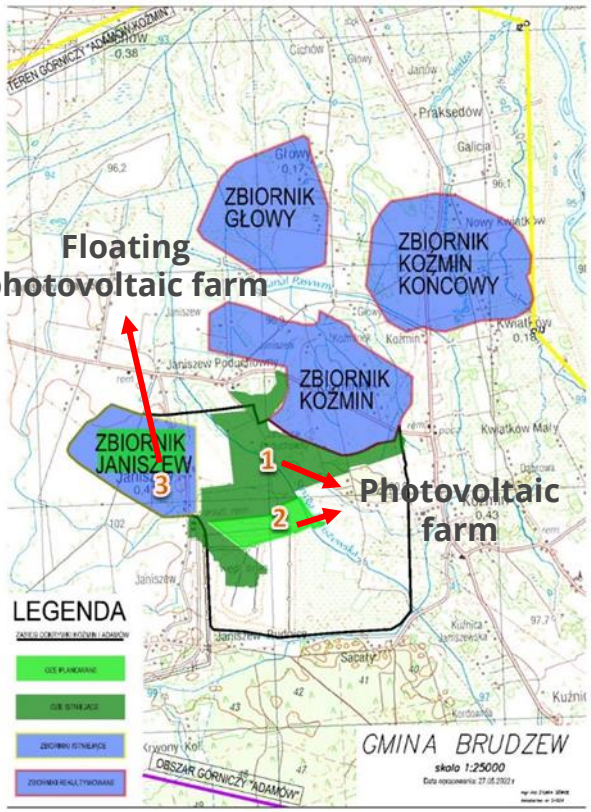
Adamów power plant, being a part of Zespół Elektrowni Pątnów-Adamów-Konin SA, was closed at the beginning of January 2018. The exclusion of the power units was dictated by the decision of the European Commission acting on the basis of the derogation described in the Directive of November 24, 2010 on the need to end the operation of generation assets of Adamów power plant at the beginning of January 2018. In 2020, the management board of PAK KWB Adamów passed a resolution on dissolution and liquidation

Source: Paweł Woszczyk, Polish Power Plants Association
LM LOKALNE MEDIA Sp. z o.o

EXAMPLES OF THE USE OF LAND AFTER MINES AND POWER PLANTS CLOSED DOWN

MOVING AWAY FROM LIGNITE - CLOSING COAL-FIRED POWER PLANTS

The process of reclamation of the nearby KOŹMIN open pit

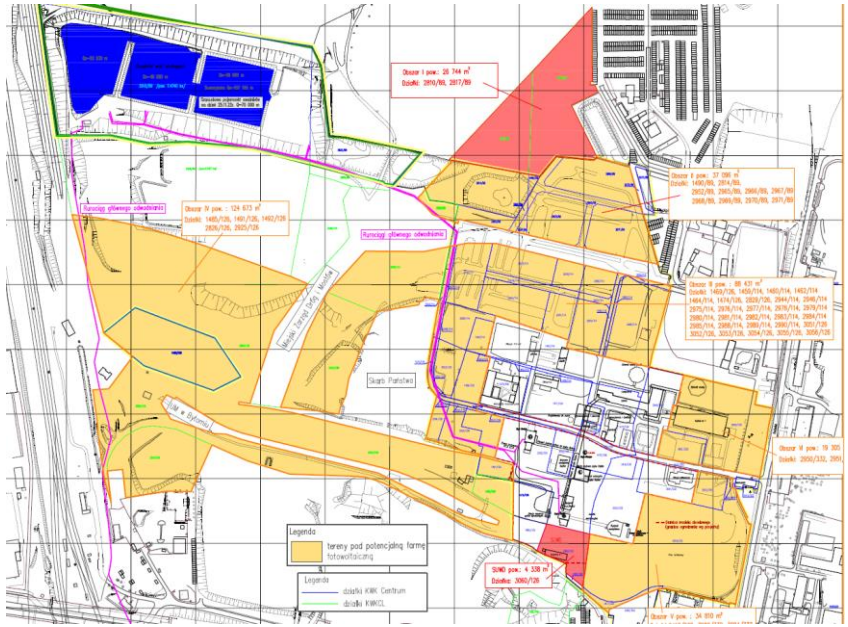


Source: Paweł Woszczyk, Polish Power Plants Association

EXAMPLES OF THE USE OF LAND AFTER MINES AND POWER PLANTS CLOSED DOWN

COAL MINE CLOSING

Project for the construction of a photovoltaic farm on the site of the former "Centrum„ hard coal mine



Source: Andrzej Chmiela, SRK, Poland

EXAMPLES OF THE USE OF LAND AFTER MINES AND POWER PLANTS CLOSED DOWN

COAL MINE CLOSING - DEVELOPMENT OF ASSETS AFTER THE HISTORIC ROZBARK MINE

Source: UM Bytom, https://www.bytomski.pl/26051-co-dzieje-sie-na-terenie-kwk-rozbark-zdjecia

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EXAMPLES OF THE USE OF LAND AFTER MINES AND POWER PLANTS CLOSED DOWN

COAL MINE CLOSING - DEVELOPMENT OF ASSETS AFTER THE HISTORIC ROZBARK MINE

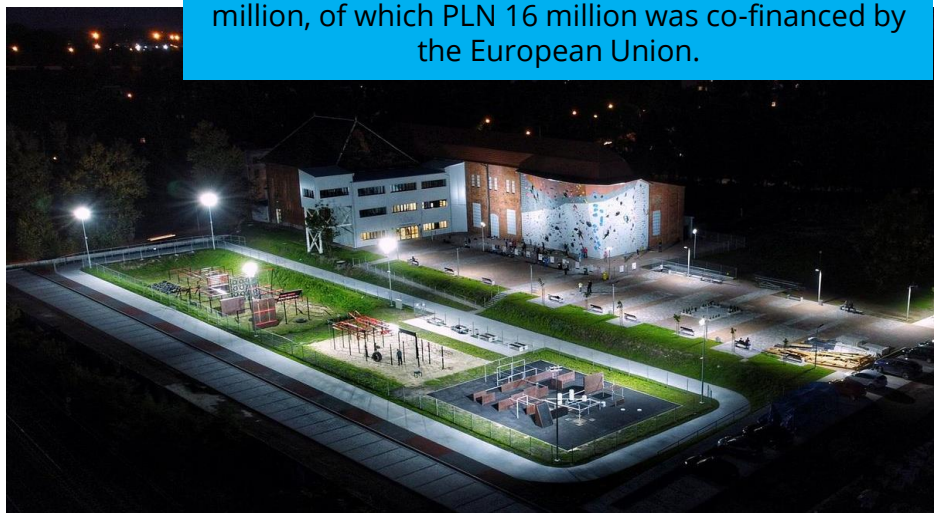
Teatr Rozbark, actually Rozbark Bytom Dance and Movement Theater - a theatre, a cultural institution of the city of Bytom, was established on October 28, 2013. The head office is located in the former, historic the pithead building of the Rozbark Hard Coal Mine, established in 1868.

Source: UM Bytom, https://www.bytomski.pl/26051-co-dzieje-sie-na-terenie-kwk-rozbark-zdjecia

EXAMPLES OF THE USE OF LAND AFTER MINES AND POWER PLANTS CLOSED DOWN

COAL MINE CLOSING - DEVELOPMENT OF ASSETS AFTER THE HISTORIC ROZBARK MINE

The value of the entire project is over PLN 23 million, of which PLN 16 million was co-financed by the European Union.



The **Climbing and Strength Sports Center** was established at the closed Rozbark Hard Coal Mine. The old "Bończyk" shaft, the former boiler room, the building of the former switching station, as well as the retaining wall, have been adapted to the needs of the Climbing and Strength Sports Center, thanks to which they still serve the residents.

"Skarpa" is one of the largest facilities of this type in Europe with a climbing area of over 3,000 m².

Source: UM Bytom, https://www.bytomski.pl/26051-co-dzieje-sie-na-terenie-kwk-rozbark-zdjecia

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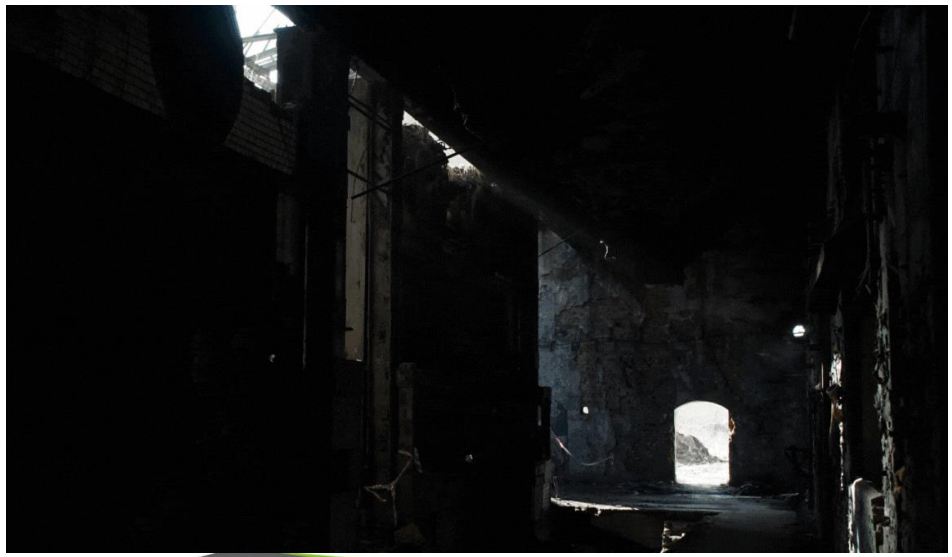
EXAMPLES OF THE USE OF LAND AFTER MINES AND POWER PLANTS CLOSED DOWN

COAL MINE CLOSING - DEVELOPMENT OF ASSETS AFTER THE HISTORIC ROZBARK MINE



source: Klub Skarpa Bytom

CONCLUSIONS

1. The ongoing transformation brings with it many challenges that are of particular importance for coal-related industries and regions.
2. An adequate preparation for transformation, including the definition of directions for the use of assets and land, planning for effective use of available resources, creating new programs that will allow for a fair transformation, determining the synergy between transformed energy and industry and local activity and joint action.
3. Managing closures appropriately and successfully depends on planning for the impacts on affected workers and communities and on the repurposing and reclamation of the affected areas.
4. Early identification of repurposing opportunities enables a comprehensive and efficient use of existing resources.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude towards all members of the RECPP and POTENTIALS projects. Both project were carried out in a consortium of 13 and 6 international partners, under the European Commission, Research Found for Coal and Steel RFCS funds, grant agreement No. 899512 and No. 101034042.

Thank you for your attention

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