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Just transition of post mining areas – technical, economic, environmental and social aspects

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Abstract:

The article is a review of papers, presentations, expert opinions concerning a just transition of post-mining areas in the light of technical, economic, ecological and social aspects, which were the subject-matter of the International Scientific-and-Technical Conference, organized by the KOMAG Institute of Mining Technology in Gliwice, Poland and the IHP Hydraulics and Pneumatics Research Institute in Bucarest, Romania. The Conference participants concentrated their discussions both on the social effects of transition, on the economic aspects of activities concerning a collaboration of circummining companies as well as on technical and technological challenges in the mines already closed down or in those which are currently subject to the closing-down processes. Some possibilities of a reorientation of the mining plants towards generating and storage of green energy were presented. It should be borne in mind that a transition of the European Economy in the direction of more green and climate friendly is one of the most important objectives determined by the European Union. In particular, it is a big challenge for mining regions such as Silesia in Poland. The transition process includes a liquidation of underground workings and of the surface infrastructure and a series of indispensable activities oriented onto a restoration of the natural environment and a protection of mining plants areas against hazards which may occur after a termination of their operation. The article is ended with some information concerning a role research institutes in the just transition of post-mining areas and a new strategy of KOMAG as GREEN INSTITUTE.

Keywords: just transition, post-mining areas, challenges, mines, closing-down process, green energy storage, green deal, green institute

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1. Introduction

At present the world is tragically effected not only by a crisis of safety and security, but an energy, economic and ecological crisis as well. We live in a very sensitive, break-through moment. Representatives of science often exchange views on the role of research organizations, in particular research institutes in the transition processes. They are responsible for an intensive search of innovative technical and technological solutions, not forgetting about new organizational solutions. As research institutes are a sort of bridge between science and industry, so they are expected to create innovations in close collaboration with business partners oriented onto industrial, climatic, energy and IT challenges. The KOMAG Institute of Mining Technology organized the International Scientific-and-Technical Conference on the just transition of post-mining areas to create a forum enabling an exchange of knowledge and experience among scientists, researchers, politicians, businessmen, representatives of local authorities and of mining plants. During the conference there was also a possibility of taking advantage of several European countries' experience in the scope of reducing a production of electric energy from hard and brown coal, according to the guidelines of the Green Deal and according to the recommendations of the process stake-holders.

The papers, presentations and discussions concentrated on the following subjects:
- Social-and-economic aspects of just transition of post-mining areas.
- Principles of transition in the light of green deal requirements.
- Advantageous factors and barriers of just transition.
- Management of post-mining areas.
- Production of green energy, its storage and management.
- Generation of new work-places and a search of market niches.
- Management of just transition processes on local and regional levels.
- Determination of just transition principles and a formulation of recommendations for different groups of stake-holders to obtain a social approval of planned changes.
- Designing and construction of equipment for a protection of underground mine workings against hazards.
- Possibilities of mining technologies transfer to foreign markets.

It should be borne in mind that the mechanism of just transition is a key tool enabling to introduce climate neutral economy in an efficient, society and environment friendly way. Just transition creates chances for local and regional development, a chance for investments in renewable sources of energy, for gaining new markets connected with green power generation, energy storage or sustainable transport. It is also a chance for increasing economic potential of post-mining areas, for a remediation of damaged areas in the result of mining operations and for a reduction of a negative impact of industry on inhabitants of these areas. The Conference was oriented onto a presentation of the Silesian Region potential, in particular in the scope of industry, scientific and research institutions as well as human resources.

The presentations were based on several publications [1-4], concerning the state's energy policy in the direction of the energy and fuel sector development, the effect of energy transition on the labour market, a contextual understanding of regional energy transitions in Europe as well as decarbonization processes. The reclamation of post-mining areas as well as the restoration of abandoned land and post-industrial sites were the subject-matter of international discussions [5]. These processes consist of creating a new land use pattern and giving new functions to areas degraded by the industry. In the case of mine closure it is particularly important to create new work-places for ex-miners [6] as well as to analyze the potential of regions, where mining is concentrated, to adapt to closure given the regional assets [7]. As regards energy storage different systems were discussed [8-10]. In the following part of this article there will be some information about hazards which may occur in mines subject to closing down processes [11]. During the Conference a lot of attention was paid to the EU citizens' perception of renewable energy transition amidst the European Green Deal and to energy transition scenarios [12, 13]. It was interesting to get some information about the assessment of renewable energy sources (RES) in Poland against the world renewable energy sector [14, 15].

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2. Thematic scope of selected papers and presentations

2.1. Diversification of energy security – world megatrends

Mr. Piotr Pyzik, Under-Secretary of State in the Ministry of State Assets, Government Plenipotentiary for the Transformation of Energy Companies and Coal Mining Industry concentrated his presentation on geopolitical conditions, confirming the world megatrends in the scope of energy security. This phenomenon is closely connected with a dissemination of renewable energy sources, a creation of local energy societies and energy storage systems and more and more advanced systems of energy management, integrating the power generating sources on local levels. The Conference programme included the discussion panel "Poland – Africa – strategic cooperation between the mining sector and RES" which seems to be of particular importance in the light of the European Union policy. The European Commission signed a contract with the African Union, allocating 150 billion Euros for a support of EU countries participating in development projects in Africa. Minister Pyzik expressed his joy and satisfaction that KOMAG, as the first Polish institution, decided to join the European Association for Storage of Energy (EASE). In his opinion it is a new functional perspective not only for Silesia but for our country. He congratulated the KOMAG Management and Employees on the initiative of establishing the "Institute of Green Transition", integrating Silesian scientists and researchers. He wished further successes in an implementation of the fourth industrial revolution in mechanization, electrification, IT and automation of the ECONOMY 4.0. This presentation was finished with best wishes for all the Conference Participants. He wished them fruitful deliberations and interesting discussions enabling to find lingua franca.

2.2. EU policy of importance to the coal and lignite mining regions

Mr. Brian Ricketts, Secretary-General of the EURACOAL Association for Coal and Lignite represented members from fourteen countries, including many from Poland. He started his presentation with describing the situation for coal and lignite in Europe (Fig. 1). Then he discussed the production of hard coal in the EU over the years 1990-2021 (Fig. 2).

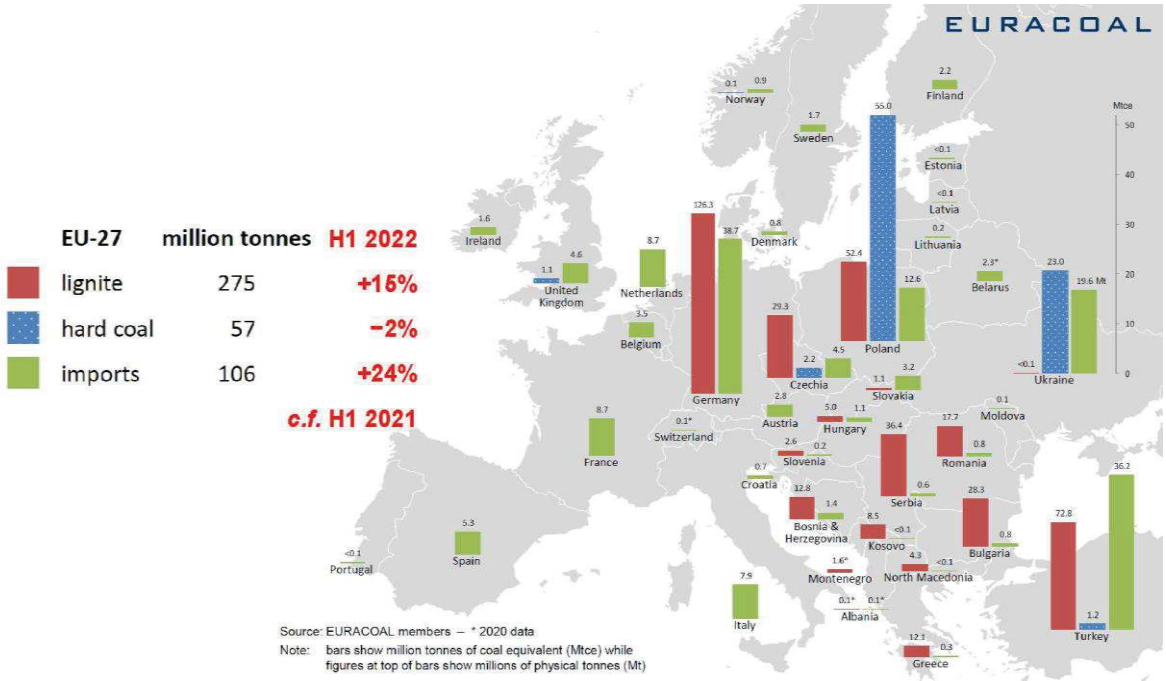

Fig. 1. Coal in Europe 2021 – lignite production, hard coal production and imports

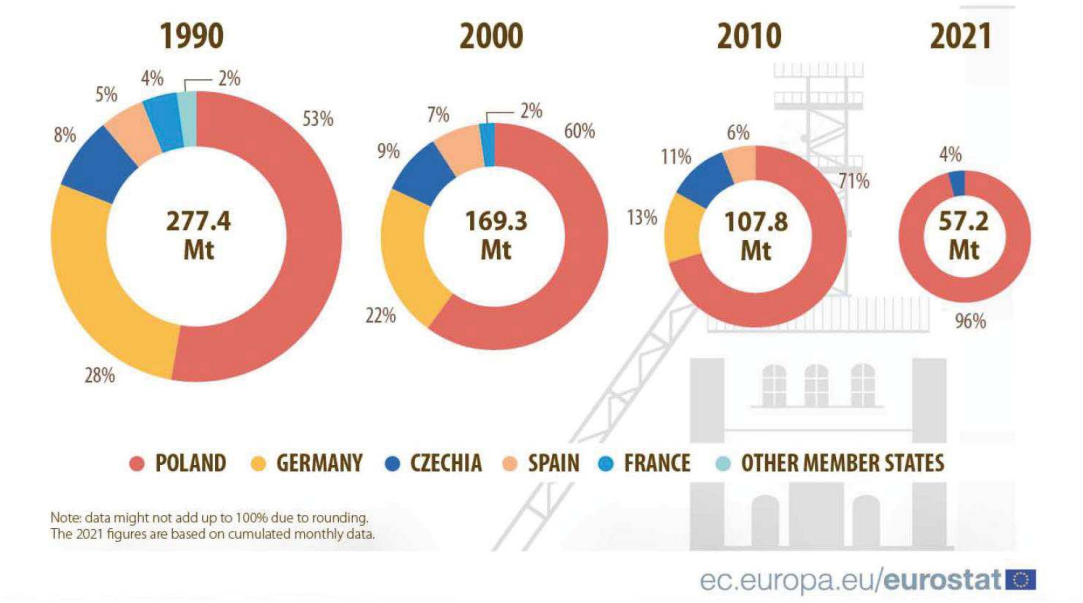

Fig. 2. Production of hard coal in the EU over the years 1990-2021 (million tonnes)

The European Commission remains committed to the European Green Deal and the 55% GHG emission reduction target for 2030 as laid down in the European Climate Law which came into force in July last year. The so-called Fit-for-55 package has yet to be adopted. It should be highlighted that the share of coal and lignite in power generation was around 17% in 2019, way less than the global average of 38% (Fig. 3).

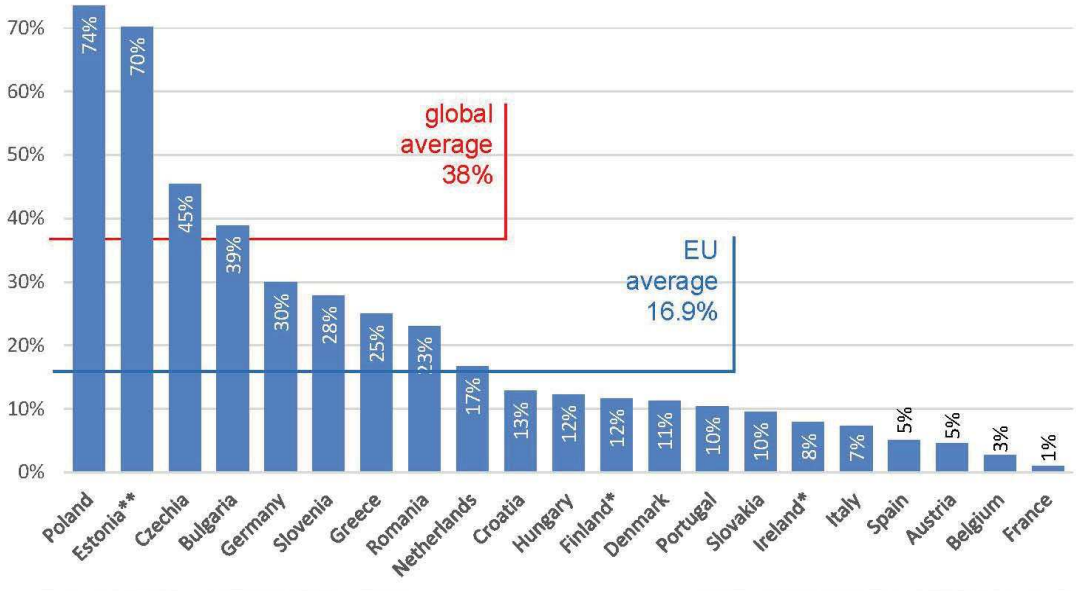

Fig. 3. Coal in EU electricity generation, 2019

The historic trend of declining coal production in Europe will not change (Fig. 4). The graph shows the evolution of coal as it powered the Industrial Revolution in Europe with some global events that changed the course of an otherwise perfect bell-shaped "Hubbert curve" – the symmetrical, logistic distribution curve for the production of any finite resource exploited in a free market economy.

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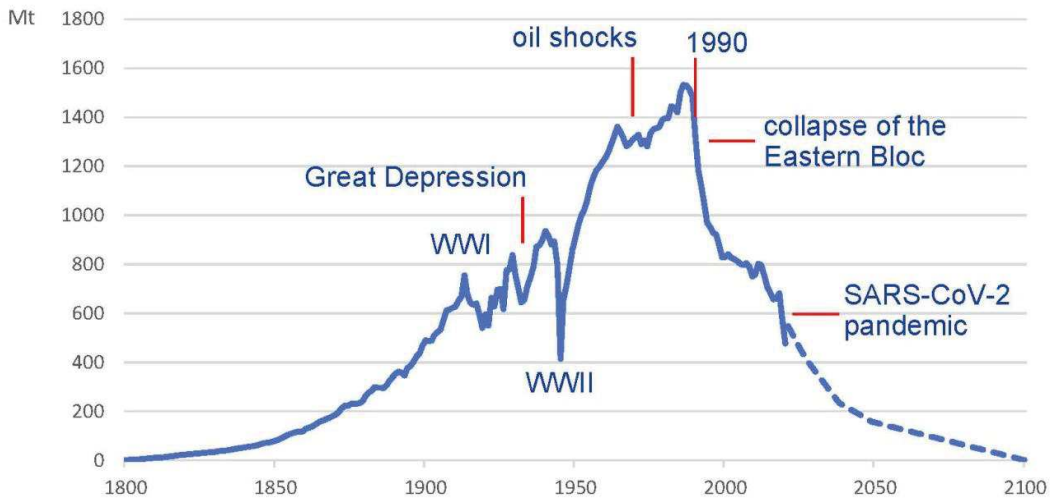

Fig. 4. European coal production 1800-2020 and forecast to 2100

Under the Green Deal, the European Commission offers a "just transition" for coal miners. The Just Transition Fund is a useful first step but nobody knows what will happen after 2027 – the end of the current EU budget. PGG, the Polish Mining Group, alone would need about 40 billion EUR to complete the transformation of its business activities to capitalise on the value chains in the coal regions.

Mr. Ricketts mentioned the EU Research Fund for Coal and Steel. It is a solid source of funding for coal-related research projects.

In conclusion he said that the coal industry was doing everything possible to guarantee Europe's energy security at a price citizens could afford.

2.3. Transition of post-mining areas on the example of the Ruhr Region

The presentation, given by Dr. Krzysztof Tajduś from the Institute of Rock Mechanics of the Polish Academy of Sciences, was oriented onto the decarbonization processes undertaken in Germany over the years 1957-2018. The following four maps show the changes in detail (Fig. 5, 6. 7, 8).

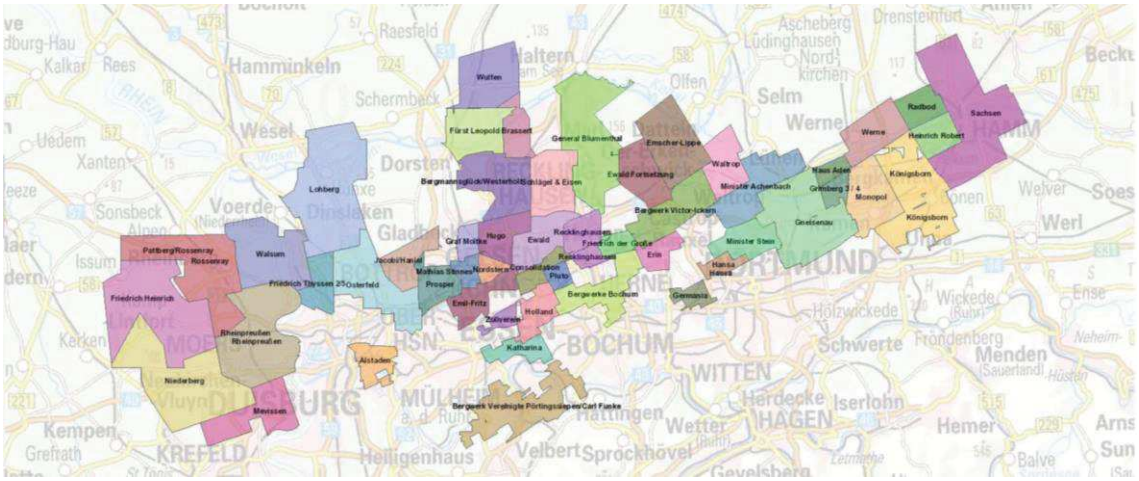

Fig. 5. Active coal mines in Germany in 1969 (Source: Prof. Anton Sroka's presentation at the meeting of the Mining Committee of the Polish Academy of Sciences)

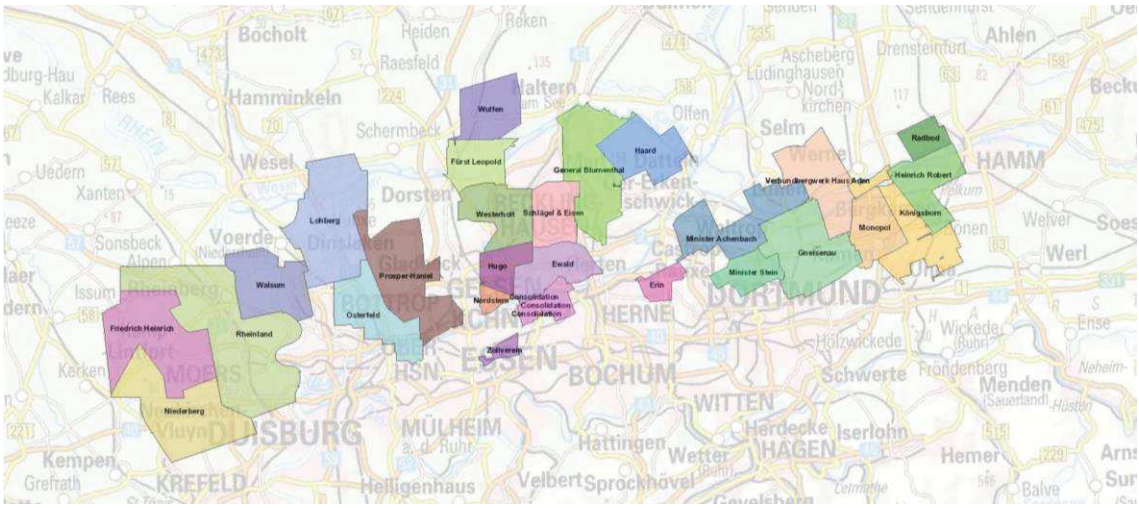

Fig. 6. Active coal mines in Germany in 1980 (Source: Prof. Anton Sroka's presentation at the meeting of the Mining Committee of the Polish Academy of Sciences)

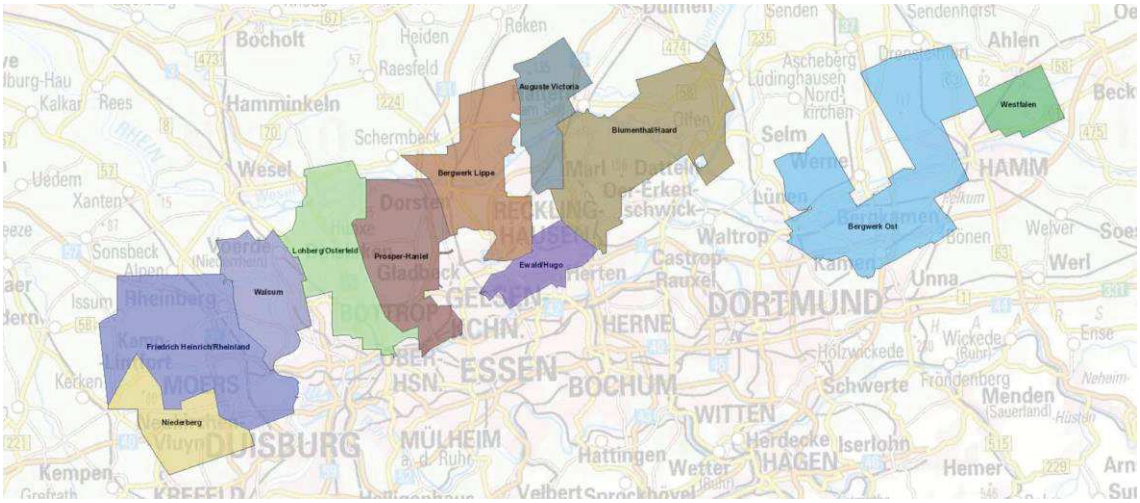

Fig. 7. Active coal mines in Germany in 2000 (Source: Prof. Anton Sroka's presentation at the meeting of the Mining Committee of the Polish Academy of Sciences)

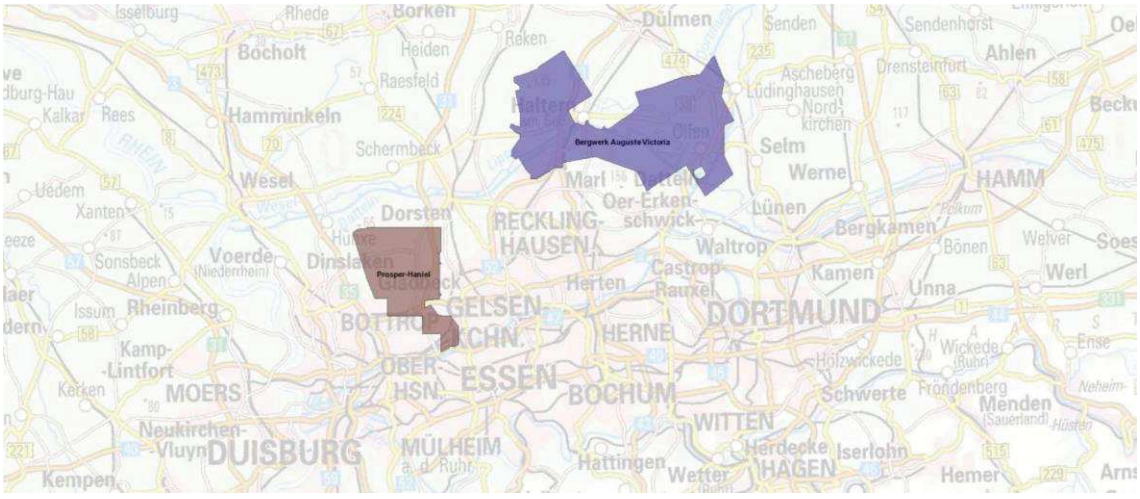

Fig. 8. Active coal mines in Germany in 2015 (Source: Prof. Anton Sroka's presentation at the meeting of the Mining Committee of the Polish Academy of Sciences)

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It should be highlighted that in 1957 there were 173 active mines, employing 607.3 thousand people, producing 149 million tonnes of coal; whereas in 1970 – 69 active mines employing 253 thousand people, producing 111 million tonnes; in 1980 – 39 active mines, employing 186.8 people, producing 87.9 million tonnes; in 2000 – 12 active mines, employing 58.1 thousand people, producing 34.3 million tonnes and in 2015 – 3 active mines, employing 9.6 thousand people and producing 6.4 million tonnes (Fig. 9).

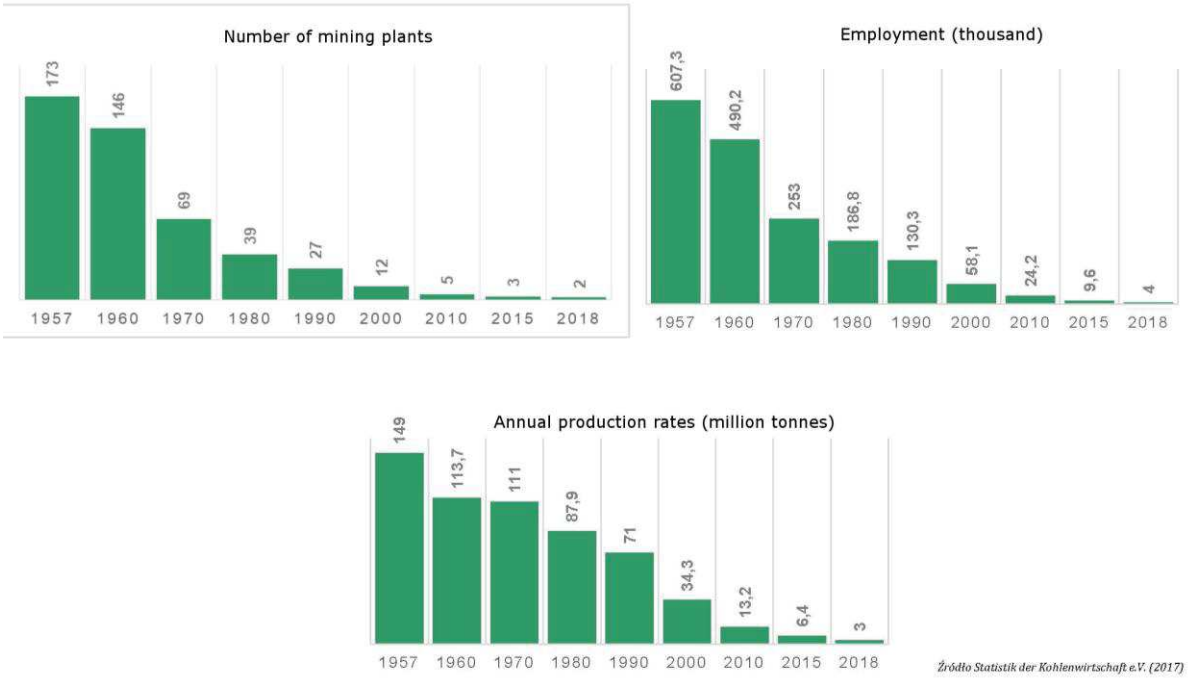

Fig. 9. Transition of the German mining industry over the years 1957-2018 (Source: Statistik der Kohlenwirtschaft e.V. 2017)

All the transition processes were planned and conducted by the RAG (Ruhrgebiet Aktiengesellschaft) established in 1960. In 2018 the subsidies for the mining processes ended and in 2019 the post-mining era started. All the RAG development stages are shown in Fig. 10.

Fig. 10. Development of RAG and its role in the transition processes (Source: RAG)

Since 2016 RAG has started the transition process from the production phase over the years 2016-2018, through the extinction phase over the years 2019-2021 to the eternity phase since 2022, (which is shown in Fig. 11).

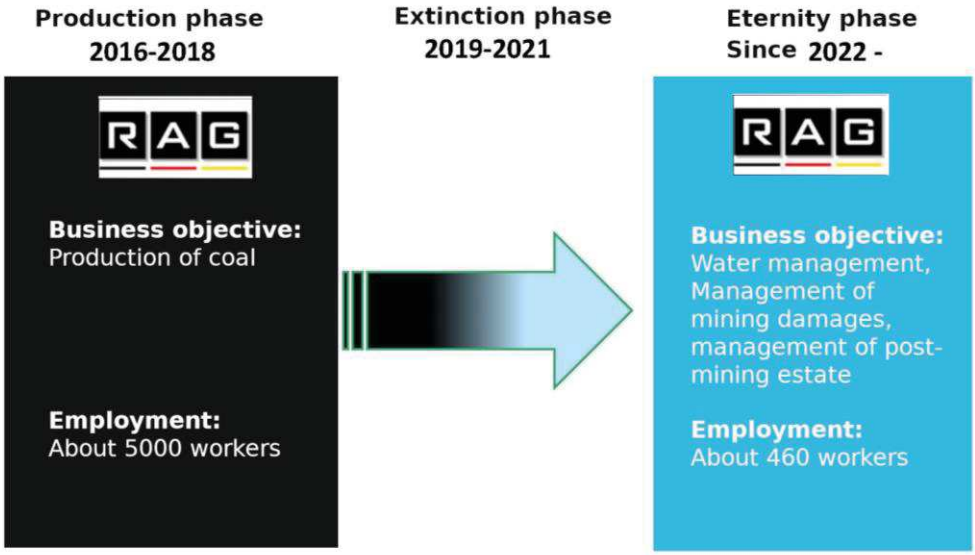

Fig. 11. Schematic diagram of transition processes conducted by RAG since 2016 up till the present time (Source: Krzysztof Tajduś's presentation at the Conference)

Analyzing the transition processes, undertaken in the German mining industry, it is worth specifying the milestones which are as follows:

- Innovativeness consisting in interdisciplinary use of the potential of universities and scientific institutions.
- A realization of programmes supporting a creation and development of the state-of-the-art technologies.
- A support of different branches and domains such as health, transport, energy and logistics.
- A use of highly developed infrastructural network such as motorways, railway systems and airports.
- An implementation of new production methods.
- A use of mining infrastructure for a development of state-of-the-art power generation technologies including photovoltaic installations on mine waste dumps, heat recovery from mine water, wind turbines on mine dumps, energy from methane, biomass, pumped-storage power stations, geotherms.

A realization of the above mentioned milestones required a reorientation of the structural policy to achieve the following objectives:

- An increase of the local identity.
- A use of mine estate for cultural institutions such as museums, centres of culture etc.
- An improvement of inhabitants' standard of living.
- A use of multi-national potential for international contacts.
- A preparation of highly-qualified personnel enabling to meet the requirements of new enterprises in the region.
- A maintenance of development unity of all the communes in the post-mining areas – the union of Ruhr Basin.

The presentation was ended with a case study concerning the Ewald mine.

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2.4. Social-and-economic conditions of the transition in the Polish coal regions

Prof. Adam Drobniak from the University of Economics in Katowice concentrated on five aspects of transition: social, economic, infrastructural, environmental and institutional. He highlighted the importance and significance of interdisciplinary collaboration oriented onto focusing knowledge and resources on a creation of new value chains. He suggested two levels of this collaboration:

– A vertical one: local – regional – state – European,
– A horizontal one: representatives of territorial administration non-governmental organizations, trade unions, research institutions, institutions of business environment, sector of education and companies.

Prof. Drobniak carried out detailed analyses of transitions of coal regions in Poland in the territorial, economic technological and institutional as well as environmental contexts (Fig. 12, 13, 14 and 15 respectively).

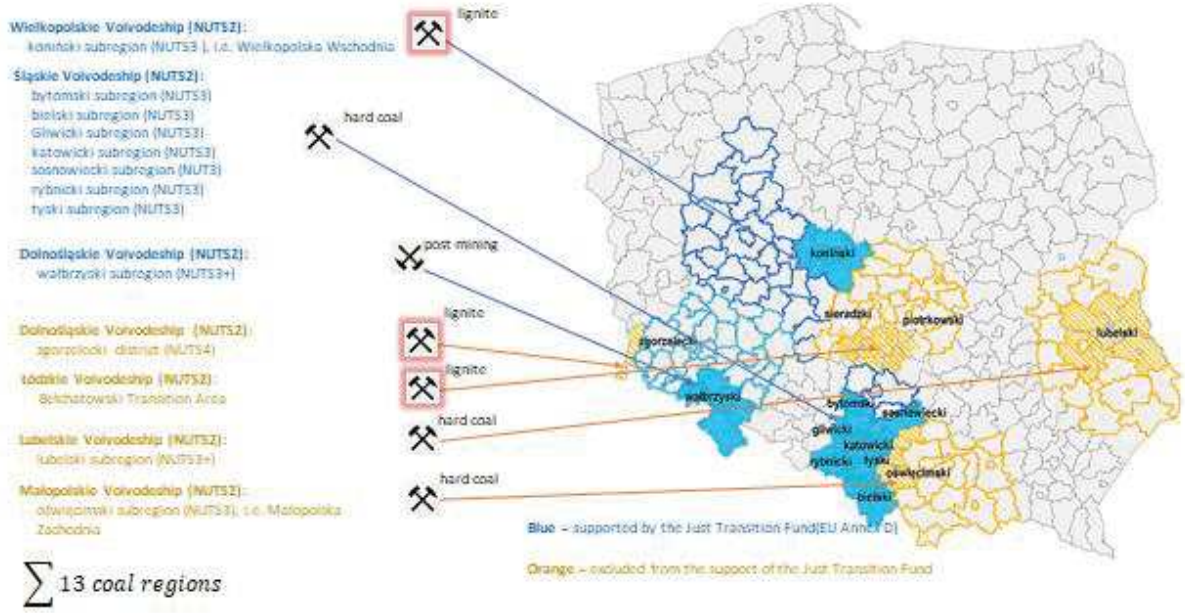

Fig. 12. Transition of coal regions in Poland in the territorial context (Source: KPST – November 2021)

Coal regions	Number of economic subjects and their dynamics 2010=100(2019)	Employment (2019)	Employment in the mining industry (2019)	Employment in related activities* (2019)
wałbrzyski	75 748 (104)	193 772	0	0
zgorzelecki	8 713 (100)	19 405	3 500	4 235
bielski	79 831 (110)	279 450	1 746	2 113
bytomski	44 328 (109)	134 318	2 784	3 369
gliwicki	51 306 (107)	191 498	7 542	9 126
katowicki	**88 295 (107)**	**353 716**	15 333	18 553
rybnicki	51 796 (107)	208 740	22,113	26 757
sosnowiecki	70 942 (99)	234 182	3 486	4 218
tyski	41 404 (112)	168 975	19 009	23 001
lubelski	76 051 (117)	311 090	5 653	6 840
bełchatowski	44 505 (107)	166 413	4 728	5 721
Zachodnia Małopolska	57 358 (107)	189 868	3 998	4 838
Wschodnia Wielkopolska	65 865 (117)	137 322	6 689	8 094

Fig. 13. Transition of coal regions in Poland in the economic context (Source: KPST – November 2021)

Coal regions	Domination level of traditional industries	Type of economic structure	Potential of institutions supporting business
walbrzyski	low	weakened post-industrial	average
zgorzelecki	high	excessive specialization	low
bielski	low	mix of industries and services	high
bytomski	high	weakened post-industrial	average
gliwicki	low	mix of industries and services	high
katowicki	low	mix of industries and services	high
rybnicki	high	excessive specialization	average
sosnowiecki	low	mix of industries and services	average
tyski	average	zrównoważona	average
lubelski	high	excessive specialization	low
bełchatowski	high	excessive specialization	low
Zachodnia Małopolska	low	mix of industries and services	average
Wschodnia Wielkopolska	high	excessive specialization	average

Fig. 14. Transition of coal regions in Poland in the technological context (Source: KPST – November 2021)

Coal region	Extraction grounds [ha]	Industry and production [ha]	Share in the region surface [%]
wałbrzyski	1 643.61	2 456.42	0.90
zgorzelecki	3 026.07	265.84	**3.93**
bielski	158.23	1 782.10	0.82
bytomski	165.78	2 364.03	1.60
gliwicki	17.79	2 815.05	**3.22**
katowicki	8.62	2 919.33	**7.70**
rybnicki	334.13	2 006.29	1.73
sosnowiecki	856.42	4 491.50	**2.97**
tyski	96.02	2 255.58	**2.49**
lubelski	945.87	1 313.76	0.28
bełchatowski	5 770.00	2 001.27	**2.12**
Zachodnia Małopolska	595.02	2 347.36	1.44
Wschodnia Wielkopolska	5 031.89	942.85	1.35

Fig. 15. Transition of coal regions in Poland in the environmental context (Source: KPST – November 2021)

Looking at the economic context, it is easy to notice a significant share of direct and indirect employment figures in traditional branches of industry, whereas in the case of the technological and institutional context a significant share of traditional branches of industry (big and medium size enterprises in the mining sector as well as in the circum-mining branches, conventional power plants, metallurgy and coking industry) can be seen. There is a deficit of the institutions supporting business. Another issue concerns a big technological sensitivity to changes and a big number of post-industrial and industrial areas including contaminated grounds.

2.5. Silesia in transformation – European Funds for Silesia for the years 2021-2027

Just transition is a process of systematic changes, oriented onto basing the economy on environmentally neutral industry. The most important element of the just transition concerns social costs of economic changes. Just transition is a chance for a development of Silesia due to the following activities:

- Investments in renewable energy sources.
- A creation of new markets connected with green energy and sustainable transport.
- A development of geographic areas and branches neglected in the result of coal exploitation.
- A remediation of urban and natural areas.
- A reparation of damages caused by an intensive coal exploitation.

All the above mentioned activities are included in the Territorial Plan of Just Transition of the Silesian Voivodeship 2030, covering the Economy – budget of 920 million EUR, the Environment – budget 763.4 million EUR and the Society – 300 million EUR. As far as the Economy is concerned, there are tree fields of activity:

- Innovative economy of mining sub-regions.
- Diversified economy of mining sub-regions enabling to save resources and save energy.
- Strong entrepreneurship of mining sub-regions.

In the scope of the Environment two fields of activity are regarded to be top priority:

- Balanced dissipation of power engineering in mining sub-regions oriented onto a dissemination of solutions based on renewable energy sources (production of energy, its distribution and storage).

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– Efficient use of post-industrial areas in mining sub-regions for economic, environmental and social purposes.

Presenting the activities of just transition, the third aspect, related to the society, should be highlighted:
– Attraction and efficient education and an improvement of qualifications in mining sub-regions.
– Complex system of social support to make inhabitants of mining sub-regions more active and open to changes.

It should be borne in mind that the Mechanism of Just Transition is a key tool enabling an efficient transformation of the economy in the way which is environmentally neutral and has no negative impact on the society. The Silesian Voivodeship is the biggest mining region in the European Union at present. The transition processes of different intensity have been realized here for more than 30 years. However, till the year 2050 the Polish mining industry will face colossal changes, resulting from the European Green Deal requirements. The transition will embrace 3 thousand hectares of grounds, nearly 5 thousand buildings and more than 6 thousand of other structures, including 30 shafts. For Silesia, whose economy has been based on mining coal for centuries, an inevitable withdrawal from this industry constitutes a unique challenge and a great development chance.

2.6. KOMAG Institute of Green Transition – 2030 as an example of changes in the scientific sector supporting the Just Transition of Post-Mining Areas

For 72 years KOMAG has been realizing the mission of automation, mechanization and electrification of industrial processes in Silesia but within less than a decade it intends to become very active in implementing breakthrough technologies in the scope of electromobility, energy storage, cybersecurity of industrial systems and a transition of urban ecosystems in the direction of the closed loop economy. The primary objectives, till the year 2030, include a transformation into the INSTITUTE of GREEN TRANSITION and an achievement of the status of the European leading research institution, having highly specialized staff and laboratories equipped with the state-of-the-art testing facilities.

ITG KOMAG, as the Institute of Green Transition, realizes the mission of becoming soon a European scientific-and-research partner, increasing efficiency, quality and security of key economic processes of its clients. The mission, defined in such a way, shapes the new strategy of the Institute for the years 2023-2030, in which a development of scientific and design activity is perceived through the business context, enabling a maintenance and an enlargement of the research and competence potential.

The strategy is based on the awareness that the KOMAG research activity plays a key role in a development of our country and of Europe and it is inseparably connected with social responsibility.

The strategy determines new areas of activity such as:
– An efficiency increase of research-and-development as well as of educational activity.
– A maximization of the Institute's present research possibilities.
– A use of the present scientific and research potential for attracting new business partners.
– An increase of using state-of-the-art development technologies.
– An increase of efficiency, competences and a change of the present organizational system.
– A development of scientific and engineering staff.

The Institute's new strategy is focused on the following fields of activity:
– Power systems sustainable climatically and economically.
– A transition of post-mining areas and power transition.
– A use of the potential of underground infrastructure and of post-mining areas.
– New technologies in the scope of energy management, generation and storage.
– A decarbonization of economy.
– Solutions for means of defence.

– A transfer of mining technologies in the aspect of occupational safety issues and a use of innovative techniques and technologies.

One of KOMAG's ambitions includes strengthening of the Institute's position on the domestic and international arenas in the scope of basic and applied research.

3. Conclusions

– The International Scientific and Technical Conference was a successful forum of knowledge and professional experience exchange among scientists, researchers, representatives of local and regional administration as well as industrialists.
– Interdisciplinary presentations and panel discussions enabled the conference participants to concentrate on varied issues experienced during a transition of post-mining areas in the light of technical, economic, ecological and social aspects.
– One of the most important Conference objectives consisted in taking advantage of the European countries in the scope of reducing energy generation from hard coal and lignite according to the European Green Deal requirements.
– Special attention was paid to a determination of the transition process principles and a formulation of guidelines for different groups of stakeholders.
– Panel discussions also concerned the most important factors favourable for the just transition of post-mining areas and barriers experienced by different groups of stakeholders.
– A role of scientists and researchers in the process of the just transition of post-mining areas was highlighted and an example of the KOMAG Institute's of Mining Technology transformation into the Institute of Green Transition – 2030 was presented and discussed.

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