

Lower Silesian Regional Profile

**Deliverable Report
Semester 2
Partner: PP06-07 – UMWD**

Dolnośląskie Voivodeship –
Marshal's Office of Lower Silesia

Wroclaw University of Science and Technology



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1. Executive Summary

Lower Silesia is among the leaders in socio-economic development among Polish voivodeships. This is indicated by a number of measurable indicators, such as GDP and GDP per capita, the level of economic activity, and business investment. The region's high position is also indicated by the position of Lower Silesian universities in national rankings, the number of units conducting R&D activities, the total amount of R&D expenditure, the number of academic staff and students, and the high quality of human capital.

The region is characterized by high economic dynamism and entrepreneurship. With approximately 2.8 million inhabitants, nearly 411,000 businesses are registered, representing approximately 8.5% of the total number of businesses in Poland. The entrepreneurship index (number of businesses per 1,000 inhabitants) is 7.0, compared to the Polish average of 7.2. This places the region fourth in Poland. The region also ranks fourth among voivodeships in terms of the number of large enterprises.

Lower Silesia is one of the most important R&D centers in Poland. Most indicators examining the research sector rank the region among the top five in the country. The region is also one of the leaders in Poland in terms of R&D spending. Furthermore, in recent years, spending growth has outpaced the national growth rate. In 2023, 1.56% of GDP was spent on R&D in Poland, compared to 1.67% in Lower Silesia. Nearly 10% of all R&D employees in Poland were employed in the Lower Silesian Voivodeship, ranking the region third in the country (behind the Masovian and Lesser Poland Voivodeships).

The region is a major domestic producer of useful minerals, including copper, silver and associated raw materials, lignite, natural gas, crushed and cut stones (igneous and metamorphic rocks accounting for 93% of domestic production), and many unique rock raw materials (e.g., bentonite, kaolin, feldspar, mica schist, magnesite). It is characterized by rich and diverse documented reserves of useful minerals, particularly rock, energy, and metallic raw materials, as well as medicinal and thermal waters. Lower Silesia has documented 26.8% of geological resources and 31.9% of industrial lignite, 99% of copper ore resources and 98% of silver resources, 95% of magmatic and metamorphic crushed and cut stones, and sand and gravel resources among the highest quality in Poland. Moreover, the voivodeship has the only or most important resources of rock raw materials in the country, such as: white-burning ceramic clays (100%), stoneware ceramic clays, fire-resistant clays (80%), clay raw materials for construction ceramics, kaolin raw materials (100%), feldspar raw materials (100%), mica schists, quartzite schists, magnesites (100%), bentonite raw materials (>50%), gypsum and anhydrite, glass raw materials.

1) Regional characteristics

Lower Silesia is located in southwestern Poland, bordering Germany (west) and the Czech Republic (south). It is the fourth-largest regional economy in Poland (GDP PLN 282 billion, or 8.3% of the country's GDP) and ranks second in terms of GDP per capita. Wrocław, Poland's third-largest city, is the regional capital.

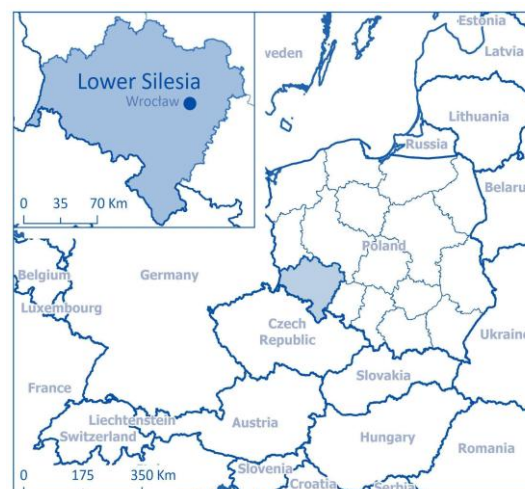


Table 1.1.1. Basic facts

Region name	Lower Silesia Voivodeship (Województwo Dolnośląskie), Poland
Population	2 857 300 inhabitants (March 2026)
Area	19,947 km ²
Population density	144 inhabitants/km ² (31 December 2024)
Regional capital	Wrocław (population: 672 929 — 3rd largest city in Poland)
GDP total	PLN 282 957 million / approx. EUR 65 billion (2024, 8.3% of Poland's GDP)
GDP per capita	PLN 96 997 — 106.9% of EU average in PPS (2024, 2nd highest in Poland)
Unemployment rate	5.8% (March 2026)
Registered enterprises	445 300 entities (REGON register, 2024)
Urbanisation rate	67.5% (national average: 59.6%) — 3rd highest in Poland
R&D expenditure	1.67% of regional GDP (2023), above the national average of 1.56%

Sources: Statistics Poland, Population and Housing Register, March 2026; Statistics Poland, Statistical Yearbook of Dolnośląskie Voivodeship 2025 (GDP, GDP per capita); Eurostat Regional Statistics 2023 (EU=100 PPS); Statistics Poland, BDL REGON enterprise register, 2024; Statistics Poland Science and Technology 2023 (R&D expenditure and employment). GDP per capita expressed as % of EU27 average in Purchasing Power Standards (PPS).

The Lower Silesian Voivodeship is administratively divided into 29 counties and 169 municipalities. Within the region, significant economic polarization persists between the dynamic Wrocław metropolitan area and the LGOM district, and the less developed Sudetes subregions. The Wałbrzych and Jelenia Góra subregions achieve GDP per capita of approximately 50–58% of the EU average, while Wrocław exceeds 120% of the EU average.

Table 1.1.2. Lower Silesian Voivodeship divided into subregions

Sub-region	Key centres	Main economic profile	GDP per capita vs. EU avg
Wrocław Metro	Wrocław	IT, automotive, finance, logistics, universities	>120% EU avg
Wrocław surroundings	Oborniki Śl., Wrocław county	Industrial parks, logistics, residential suburbanisation	~95–105% EU avg
Legnica-Głogów (LGOM)	Lubin, Legnica, Polkowice, Głogów	Copper & silver mining, smelting, chemicals	~85–95% EU avg
Wałbrzych (Just Transition)	Wałbrzych, Świdnica	Post-coal transition, SEZ, automotive components	~50–58% EU avg
Jelenia Góra / Sudeten	Jelenia Góra, Kamienna Góra	Tourism, stone quarrying, glass, ceramics	~52–58% EU avg

2) Natural resources and the mining sector

Lower Silesia is Poland's most important and most diverse mineral resource region. Analysis of the Mineral Resources Balance (PGI-PIB, as of December 31, 2024) confirms that the region is distinguished by both a concentration of strategic metallic minerals and numerous rock and chemical raw materials, often unique in the country.

Table 1.2.1. Overview of Mineral Reserves Base

Mineral commodity	Share of national reserves	% share	Strategic significance
Copper ore (metallic Cu)		60 % of national reserves	Critical/Strategic (CRMA)
Silver (Ag)		65 % of national reserves	non-critical raw materials used in the renewable energy sector
Nickel ore		100% of national reserves	Strategic (CRMA)
Feldspar		99% of national reserves	Critical (CRMA)
Kaolin		100% of national reserves	Industrial mineral
Magnesite		100% of national reserves	Industrial mineral
Granite deposits		98% of national reserves	Construction, industrial mineral
Refractory clays		80% of national reserves	Industrial mineral
Bentonite		50% of national reserves	Industrial mineral
Crushed & block stone production		42% of national reserves	Infrastructure
Sand & gravel deposits		18% of national reserves	Construction aggregates
Brown coal (industrial reserves)		32% of national reserves	Energy

Source: Mineral Balance of Poland 2025 (PIG-PIB); Lower Silesia Marshall's Office data.

The most significant economic resource base for Lower Silesia is the copper and silver ore deposit located in the Legnica-Głogów Copper District (LGOM). Poland has balance reserves of approximately 3.49 billion tons of copper and silver ore, containing approximately 55.35 million tons of metallic copper and 163,58 tons of silver. The majority of these strategic reserves are located in the Lower Silesian region, making it one of the most important European mining centers, with annual ore production expected to reach 30.12 million tons in 2024. Lower Silesia is the only place in Poland with nickel ore deposits with balance reserves exceeding 17 million tons of ore (containing approximately 125,000 tons of pure metal). The region's dominant position is also evident in the rock raw materials sector, particularly igneous and metamorphic rocks such as granite, basalt, melaphyre, porphyry, gneisses, and marble. Lower Silesia contains as much as 51.8% of the country's reserves of these

minerals and accounts for 42.4% of their extraction. Granites enjoy a special status – the region contains 86 of Poland's 97 documented deposits, representing over 98% of the country's economic reserves. A similar concentration is noted for basalts (36 of Poland's 41 deposits) and most diabase, gabbro, and melaphyre deposits. Of particular significance are the vast potential reserves of anhydrite and gypsum in the Fore-Sudetic Monocline and LGOM, estimated at up to 68.68 million tonnes. It is also necessary to mention natural aggregates (505 deposits of sand and gravel with extraction exceeding 171 million tonnes per year).

Another regional pillar are specialized raw materials for the ceramics and glass industries. This includes glass sands found in the Sudetes and feldspar raw materials, over 99% of which are found in Lower Silesia. The region is also a key producer of refractory clays (including the active Rusko-Jaroszów deposit), boasting 16 documented mineral deposits for kaolin production and the majority of the country's deposits of white-burning ceramic clays.

Chemical minerals such as barite, fluorite, and rock salt complement the structure. The raw material base also includes rich reserves of medicinal and thermal waters, which underpin the operation of numerous statutory health resorts in the region.

Table 1.2.2. Key Mining Sub-sectors

Sub-sector	Main operator(s)	Annual output (2024–25)	CRMA relevance
Copper & silver (underground)	KGHM Polska Miedź S.A.	~30.5 Mt Cu ore/yr	Cu — CRM, Strategic; , Re,Te, Se
Crushed & block stone (granite, basalt, etc.)	~126 quarry operators	>36 Mt/yr (2025)	Construction supply chain; aggregates for infrastructure
Lignite (open-cast)	PGE GiEK — Turów mine	~7–10 Mt/yr	Energy security
Industrial minerals (kaolin, feldspar, refractory clays)	Multiple SME operators	Significant;	Ceramics, glass, refractories; feldspar listed as CRM
Sand & gravel	244 operations supervised	>180 Mt/yr	Construction aggregates; high quality deposits
Natural gas (borehole)	5 active borehole operations	Variable	Regional energy security
Medicinal & thermal waters	9 spa operations + 2 geothermal	11 active operations	Balneology, health tourism, potential geothermal energy

Sources: OUG Wrocław, register 31 XII 2025; PIG-PIB Mineral Balance 2024; KGHM Polska Miedź S.A. Annual Report 2024; PGE GiEK S.A.; Marshall's Office

According to data from the District Mining Office in Wrocław, at the end of 2025, a total of 411 open-pit mines were operating in Lower Silesia, confirming the region's dominant position in the national

rock and aggregate mining sector. The table below presents their structure by deposit development status.

Table 1.2.3. Mining Operations by Type and Status (31 December 2025)

Commodity group	Total	Active	Not started	Suspended	Closing / reclaim.	<2ha ops	>2ha ops
Lignite	1	1	—	—	—	—	1
Crushed & block stone	126	99	4	7	16	13	113
Gypsum / limestone / chalk	10	8	—	—	2	—	10
Sand & gravel	244	122	5	5	112	73	171
Clay minerals	21	14	—	1	6	5	16
Other (specialty minerals)	9	5	—	3	1	—	9
TOTAL	411	249	9	16	137	91	320

Source: District Mining Authority Wrocław (OUG Wrocław), December 2025. Surface quarry operations only; underground and borehole operations shown separately.

Mining sector remains strongly focused on the extraction of sand and gravel (244 plants) and crushed and block stones (126 plants), which together constitute 90% of all supervised units. Mining fees from crushed and block stone extraction alone exceeded PLN 59.7 million in 2025, constituting a significant source of revenue for local governments.

The significant share of plants in the decommissioning and reclamation phase is noteworthy – 137 plants (33.3% of the total), the vast majority of which (112) are in the sand and gravel sector. Post-mining areas represent a potential resource for reclamation projects aligned with the circular economy.

The structure is complemented by 21 clay mines and nine plants extracting specialty minerals, including kaolins and feldspars – raw materials of strategic importance to the domestic and European supply chains of the ceramics and glass industries.

2. Policy & Governance Context

Mineral extraction in Poland is regulated at the national level. The most important act regulating mineral ownership, mineral extraction, management, supervision, execution, and oversight of mining operations, geological works, and liability for damage caused by mining operations is the Act of June 9, 2011 – Geological and Mining Law (consolidated text: Journal of Laws of 2026, item 69, as amended). Mining waste management in Poland is primarily based on the Act of July 10, 2008 on Mining Waste (consolidated text: Journal of Laws of 2022, item 2336). The overarching document at the regional

level, defining the region's challenges and socio-economic and environmental policies, is the Lower Silesian Voivodeship Development Strategy 2030. This document identifies "Responsible use of resources and protection of natural environment and cultural heritage values" as one of the region's main development goals.

This goal is achieved through sectoral policies, i.e., strategic, programming, planning, and financial documents. The document defining the region's main challenges in the area of protection and preservation of environmental resources is the current Lower Silesian Voivodeship Environmental Protection Program for 2022-2025, with an outlook to 2029. Among the most significant environmental challenges in the region are: improving air quality, rational use of natural resources, and nature and landscape protection.

One of the sectoral strategies adopted in the region is the Lower Silesian Innovation Strategy, which serves as the basis for the region's structured innovation policy. The strategy identifies seven regional specializations, including natural and secondary raw materials. Based on the priorities defined in the Strategy, support is provided for projects in the areas of mineral extraction, raw materials from waste, and mineral processing.

1) Mineral extraction

Mineral extraction activities involve interference with the natural environment. Exploitation of deposits leads to the irreversible depletion of natural resources, the transformation of the land surface, and impacts groundwater and other components of the natural environment. Mineral deposits are non-renewable, meaning that once they are depleted, their original state cannot be restored. Therefore, mining activities in Poland and Europe are strictly regulated by law, which defines the principles of deposit protection and the conditions for mining. Of particular importance is the institution of State Treasury mining property, which covers the most economically important minerals, listed in Article 10, Sections 1 and 2 of the Geological and Mining Law (including deposits of hydrocarbons, hard coal and lignite, metal ores, radioactive element ores, and rare earth elements).

The basic instrument for legal control of mining activities is the concession for the extraction of minerals from deposits. A concession defines the operating conditions, the scope of exploitation, and the entrepreneur's obligations related to environmental protection, safety, and rational deposit management. It is an administrative decision and constitutes a necessary condition for the legal conduct of mining operations.

The administrative procedure for granting a concession for the extraction of minerals from deposits is regulated primarily by the provisions of the Geological and Mining Law, with appropriate application of the Code of Administrative Procedure and the Business Law. A concession constitutes a public-law form of regulation for business activities involving the exploitation of mineral deposits and is constitutive in nature, as only obtaining one entitles the entrepreneur to legally conduct mining activities. Pursuant to Article 21, Section 1 of the Geological and Mining Law, activities involving the extraction of minerals from deposits may be conducted only after obtaining a concession. Concession-based activities in Lower Silesia are of significant economic and financial importance.

Mineral extraction generates significant revenues from mining fees, which constitute an important source of revenue for local government units. The largest share of revenue from mining fees in 2025

was generated by crushed and block stones, for which the fees exceeded PLN 59.7 million. Significant revenues also came from the extraction of natural aggregates and clays. The total value of mining fees related to solid minerals extraction exceeded approximately PLN 71 million. This confirms that the mining sector remains a key element of the Lower Silesian Voivodeship's economy, significantly impacting both regional development and the country's resource security.

2) Mining waste management

Mining waste management in Poland is based on the principles for waste producers and holders specified in the Act of 10 July 2008 on Mining Waste (Journal of Laws 2022, item 2336). This Act implements Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC (OJ L 102, 11.04.2006, p. 15). The producer and/or holder of mining waste is obligated to:

- use methods of exploration, identification, extraction, processing, and storage that prevent the generation of mining waste or keep its quantity to the lowest possible level, as well as limit the negative impact on the environment or the threat to human life and health, taking into account the best available techniques;
- limit the negative impact of mining waste on the environment, human life and health, and prevent or reduce, to the greatest extent possible, any adverse effects on the environment and human health resulting from mining waste management, even after the closure of mining waste disposal facilities, taking into account the best available techniques;
- prioritize waste recovery, and if recovery is impossible for technological reasons or economically unjustified, dispose of it in accordance with environmental protection requirements or the mining waste management program, taking into account the best available techniques;
- transferring mining waste that cannot be recovered for technological or economic reasons to the nearest locations where it can be disposed of using the best available techniques, in particular to mining waste disposal facilities.

Any waste holder planning to conduct mining, processing, or waste disposal operations is required to submit a mining waste management program to the Voivodeship Marshal (or the District Head or the Regional Directorate for Environmental Protection) before commencing such operations and obtain a decision approving the program (Article 11, Section 1 of the Mining Waste Act). This program contains information about the applicant, a description of the waste, a description of the waste generation processes, methods for minimizing waste volume and limiting its negative environmental impact, a specification of storage, recovery, or disposal methods, and a description of the closure of the mining waste disposal facility, including site reclamation and post-closure procedures and monitoring.

The largest amounts of mining waste in Poland are generated in the Lower Silesian and Silesian Voivodeships, where the mining industry is concentrated. This waste accounts for approximately 56% of all industrial waste generated (Statistics Poland, 2023). To characterize waste management in Lower Silesia, data on mining waste were obtained from the Environmental Instruments Department and the Waste Management Department of the Marshal's Office of the Lower Silesian Voivodeship. This data is collected from annual reports submitted by businesses to the Database on Products, Packaging, and Waste Management (BDO, 2026). In the Lower Silesian profile, mining waste management is

characterized for the years 2020-2025. In the database, this waste is classified into fourteen categories in accordance with the Waste Catalogue (Journal of Laws 2020.10) as:

- 01002 wastes from mineral non-metalliferous excavation
- 010180 waste rock from copper, zinc, and lead mining
- 010381 wastes from the flotation enrichment of non-ferrous metal ores other than those mentioned in 010380
- 010399 wastes not otherwise specified
- 010408 waste gravel and crushed rocks other than those mentioned in 010407
- 010409 waste sand and clays
- 010410 dusty and powdery wastes other than those mentioned in 010407
- 010411 wastes from potash and rock salt processing other than those mentioned in 010407
- 010412 tailings and other wastes from washing and cleaning of minerals other than those mentioned in 010407 and 010411
- 010413 wastes from stone cutting and sawing other than those mentioned in 010407
- 010504 freshwater drilling muds and wastes
- 010505 oil-containing drilling muds and wastes
- 010508 chloride-containing drilling muds and wastes other than those mentioned in 010505 and 010506
- 010599 wastes not otherwise specified

112 Mining Waste Management Programmes (PGOW) approved	18 Authorisations: Extraction of waste from disposal facility	3 Authorisations: Closure of mining waste disposal facility	2 Permits: Operation of mining waste disposal facility
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Decisions issued by the Marshall of Lower Silesia Voivodeship as competent authority under the Act of 10 July 2008 on Mining Waste (transposing Directive 2006/21/EC).

3. Regional Mining Innovation Ecosystem

Lower Silesian Voivodeship is the region with one of the greatest potentials in the area of R&D activity in Poland, as reflected in indicators describing R&D activity, such as entities, personnel, and internal R&D expenditures. Compared to the EU average, the Lower Silesian Voivodeship is characterized by lower values of indicators such as R&D expenditures in the enterprise sector (75.8% compared to the EU average in 2024), innovation expenditures in relation to the number of employees (54.4% compared to the EU average in 2024), and the share of R&D personnel and researchers in total employment (2.21% for the Lower Silesian Voivodeship compared to the EU average of 2.39%). Factors

that can positively influence the Lower Silesian Voivodeship's significant share of research and development activities nationwide include: a large, growing academic and research center in Wrocław, a large R&D workforce, a rich market of highly specialized specialists, the development of enterprises, including those requiring R&D resources, as is the case with high-tech industries, well-functioning business support institutions, and growing cluster initiatives.

The Lower Silesian Voivodeship Development Strategy outlines, among other things, the goal of stimulating economic activity and increasing the competitiveness and innovation of the voivodeship's economy. The local government supports the region's competitiveness and innovation through the Lower Silesian Innovation Strategy 2030, an operational and implementation document serving as a tool for implementing the development strategy's provisions. To achieve a more effective and focused spending of European and national funds, Poland, as an EU member state, has adopted the concept of smart specializations. Smart specializations in Poland have been identified at the national and regional levels. At each level of support, they identify priority areas representing current or emerging competitive advantages that can help the country and region compete in external markets, as well as contribute to economic growth, improving the quality of life and the natural environment by focusing public and private investments on innovation. Smart specializations focus on support for research, development, and innovation (R&D&I) in national and regional operational programs.

Since January 2021, seven smart specializations have been in effect in Lower Silesia:

1. Chemistry and Medicine
2. Auto-Moto-Aero-Space
3. **Natural and Secondary Raw Materials**
4. Machinery and Equipment
5. "Green Deal" – horizontal specialization
6. "Industry 4.0" – horizontal specialization
7. "Technology-Assisted Living" – horizontal specialization.

One of the identified specializations is the "Natural and Secondary Raw Materials" specialization. This specialization covers areas related to the extraction of mineral resources and the extraction of raw materials from waste.

Lower Silesia has abundant raw material resources, as well as experience in their processing. The region is home to entities operating in the extraction and processing of mineral resources on an international scale, and there are also a number of companies that supply or subcontract their services. This type of activity constitutes a significant sector of the Lower Silesian economy. Furthermore, the region is one of the main centers of innovation and R&D in Poland.

In the context of the green transformation and the development of a circular economy, interdisciplinary collaboration between the business sector, scientific and research and development institutions, non-governmental organizations, and public administration is crucial. These institutions play a strategic role in the education process and the implementation of innovative solutions that

enable effective adaptation to the requirements of sustainable development. Thanks to their expert knowledge and extensive network of collaborations, they can support both large enterprises and innovative technology startups, creating conditions conducive to the effective implementation of sustainable development strategies.

Business environment institutions (BEIs) play a crucial role in shaping the space for innovation. Their role is to support businesses and create connections between administration, science, and business, including innovation centers, i.e., entities whose operational strategy includes supporting broadly understood enterprise innovation. The Lower Silesian Voivodeship hosts dozens of business environment institutions and companies that support entrepreneurs in the process of creating, running, and developing their businesses, including training, consulting, implementing projects based on modern technologies, R&D services, and more. They offer a variety of instruments, including financial ones, such as low-interest loans for projects aimed at increasing energy efficiency, implementing renewable energy sources, or purchasing low-emission vehicles. Furthermore, they provide support in obtaining funding for innovative projects, provide advisory services, and serve as platforms for the exchange of knowledge and experience, and the establishment of business relationships between entities striving to develop a sustainable economy. Regional Development Agencies (RDA), institutions supporting entrepreneurship, innovation, and local governments. They offer companies access to financing (e.g. low-interest loans), EU grants, training and consulting services.

Table 3.1. Business environment institutions

Name of the organisation	Main area of activity
Regional Development Agency AGROREG arr@agroreg.com.pl	The main goal of establishing the Agency was to create a capital institution that would work to restructure, develop, and disseminate European Union standards in an area with high unemployment. - Activities for the development of entrepreneurship and the reduction of unemployment - Information, training, and advisory services for the micro, small, and medium-sized enterprise sector and individuals intending to start a business
ARLEG arleg@arleg.eu	- economic activities to support regional development and small and medium-sized enterprises - cooperation with local governments and the non-governmental sector - creation of new jobs - implementation of standards and norms consistent with European requirements - obtaining sources of development financing (e.g., aid programs) - supporting regional restructuring processes - improving the quality of education and consulting - supporting local and regional initiatives - inspiring partnerships between domestic and foreign entities in the field of local development - creating and managing business incubators, technology incubators, technology parks, and industrial parks - substitute investor services

	- creating and managing loan funds and seed capital funds - supporting entrepreneurship and innovation
Lower Silesian Regional Development Agency www.darr.pl	- Building a strong, highly competitive economy in the region, based on the diversity of industrial sectors and the business activity of small and medium-sized enterprises - Supporting the development of the competitiveness and business efficiency of small and medium-sized enterprises while simultaneously contributing to the development of employee skills
Lower Silesian Agency for Economic Cooperation DAWG www.dawg.pl	- supporting entrepreneurship - stimulating regional innovation - improving the competitiveness of enterprises - stimulating the development of entrepreneurs - shaping the voivodeship's image abroad
Karkonosze Regional Development Agency www.karr.pl	- Support for local governments, social organizations, and entrepreneurs - Financing the development of SMEs' business activities through loan funds, specialized consulting and information services, searching for new markets, organizing conferences, training courses, seminars, study tours, cooperation exchanges, trade fairs, and other socio-economic events
Wrocław Agglomeration Development Agency ARAW www.araw.pl	- support for Polish and foreign enterprises not only during the investment process, but also long after the entity starts its operations
Wrocław Regional Development Agency www.warr.pl	- Support for entrepreneurship, innovation, and regional economic development - Assistance in obtaining funding from EU programs for business development - Support through loan funds for SMEs - Specialized consulting and information services for SMEs.

Technology Transfer Centers (CTTs), which focus on transferring research results to the economy, commercializing innovations, and supporting businesses in implementing solutions that support green transformation. CTTs operate at the intersection of science and industry, supporting businesses in research and development (R&D), seeking financing for innovative projects, and developing various strategies, including energy transition strategies.

Table 3.2. Technology Transfer Centres

Name of the organisation	Main area of activity
Wrocław Center for Technology Transfer (WCTT) Wrocław University of Science and Technology www.wctt.pwr.edu.pl	WCTT is one of the national leaders in the commercialization of research results, ensuring the effective transfer of knowledge and technology to an innovative economy. - Commercialization of research results - Encouraging research and technology collaboration - Supporting innovative enterprise activities

Center for Technology Transfer Wroclaw University https://ctt.uwr.edu.pl/kontakt/	- Supporting the scientific and technological potential of the University of Wrocław - Transferring scientific results to the economy - Direct commercialization of research results
Center for Technology Transfer Wroclaw Medical University	- Support in the commercialization process - Collaboration with scientists and businesses through support at every stage – from invention submission to market implementation
Center for Knowledge Transfer, Innovation and Commercialization Wroclaw University of Economics and Business https://uew.pl/jednostki/universytet-ekonomiczny/centrum-transferu-wiedzy-i-innowacji-oraz-komercjalizacji/	- Support in the commercialization process - Assistance in establishing collaboration with the research team necessary to implement innovation voucher projects - Knowledge transfer through the support of scientific experts providing expertise, analyses, opinions, or services based on the university's research infrastructure - Confirmation of collaboration between business and research partners in the implementation, joint implementation of R&D work, and commercialization of its results - Support in formalizing science-business collaboration - Advice on intellectual property protection.
The Center for Innovation and Business (CIB) Wrocław University of Science and Technology www.biznes.pwr.edu.pl	- Supporting the development of innovation and research at the intersection of science and business. - Supporting research centers at Wrocław University of Science and Technology. - Organizing events and meetings dedicated to innovation, new technologies, and business cooperation.

Science and Technology Parks provide space for innovative technology companies, laboratories, and support for startups. Lower Silesian parks also offer specialized consulting services, including funding acquisition, as well as financial instruments such as industry loans, investment loans, working capital loans, development loans, and liquidity loans.

Table 3.3. Science and Technology Parks

Name of the organisation	Main area of activity
Lower Silesian Science and Innovation Park https://dpin.pl/	- Integration of research and development activities with industry - Commercialization of research - Support for entrepreneurs and aspiring entrepreneurs.
Wroclaw Technology Park https://www.technologypark.pl/	- Creating conditions for utilizing the scientific and industrial potential of Wrocław and the whole region

	- Stimulating the development of the high-tech industry - Creating infrastructure to provide enterprises with the conditions to generate innovation - Transferring new technologies to existing and newly established businesses - Commercializing research results, conducting research, development, and implementation work in the field of biotechnology and engineering - Collaborating with domestic and foreign innovation centers
Wrocław Industrial Park https://wpp.wroc.pl/	The Wrocław Industrial Park was established on March 14, 2005. Over 250 companies from nearly 60 industries operate within the park. It boasts a well-developed infrastructure (facilities, warehouses, offices, a railway siding, and utility networks) that supports business development.

New entrepreneurs can also take advantage of the services offered by **business Incubators and technology Incubators**. These institutions primarily provide office space, co-working spaces, conference and training rooms, as well as information, consulting, and training services.

Seed capital funds, credit guarantee funds, and loan funds (Lower Silesian Development Fund, Lower Silesian Economic Fund) play a significant role in financing the green transformation of businesses, enabling them to implement innovative solutions in the areas of sustainable development, energy efficiency, and the circular economy. Thanks to the financial instruments they offer, businesses can more effectively reduce their environmental impact and increase market competitiveness through innovative, eco-friendly solutions. These entities provide capital for the development and testing of new green technology solutions, as well as collateral for loans and credits, reducing barriers to accessing financing for companies implementing eco-friendly solutions.

The **clusters** operating in the Lower Silesian Voivodeship also contribute to the regional transformation of the economy towards low-emissions and sustainable development. By integrating companies, research institutions, and local governments, they support the development of renewable energy sources, electromobility, the circular economy, and energy efficiency. Clusters organize training courses, conferences, and workshops for entrepreneurs, among other initiatives, which contribute to increasing environmental awareness and promoting best practices in sustainable development.

These entities can also serve as partners, supporting the green transformation processes of manufacturing enterprises with their experience, including the implementation of innovations.

There are 32 higher education institutions in Lower Silesia (according to data from the Central Statistical Office as at the end of 2024), offering undergraduate, engineering, master's and doctoral programmes. The most important institutions from the perspective of staff training and scientific and economic cooperation within the Lower Silesian mining ecosystem are the largest public higher

education institutions and several non-public entities. The group of research entities also includes State Research Institutes and private research and development centres.

Table 3.4. Academic, Research and Development Institutions related to mining ecosystem

Institution	Profile	Role
Wrocław University of Science and Technology https://pwr.edu.pl/en/	Flagship public technical university (Wrocław University of Science and Technology – PWr); disciplines relevant to the mining ecosystem: mining engineering, geoengineering, geotechnics, geoinformatics, geodesy, environmental engineering, process engineering and materials science, robotics, mechanical engineering, occupational safety	EQF levels 5–8; supply of engineering and research graduates for the mining, metallurgy and environmental sectors; member and coordinator of EU research consortia (e.g. MINOTAUR, BrineRIS); close R&D collaboration with KGHM and other industrial partners
University of Wrocław https://uwr.edu.pl/en/	Flagship comprehensive public university; disciplines relevant to the mining ecosystem: geology, mineralogy, engineering geology, geochemistry, hydrogeology, petrology, crystallography; well-equipped geoscience laboratories and natural-history collections	EQF levels 5–8; supply of geoscientists and geologists for mining companies, geological surveys and environmental consulting; strong international collaboration in raw-materials research
Wrocław University of Environmental and Life Sciences https://upwr.edu.pl/en/	Public university of environmental and life sciences; disciplines relevant to the mining ecosystem: environmental and soil sciences, water management and hydroengineering, geodesy and cadastre, landscape architecture, agricultural and forest engineering	EQF levels 5–8; supply of specialists in land reclamation, environmental impact assessment, water management and monitoring – key competences for post-mining land rehabilitation; cooperation with regional land authorities and water utilities
Wrocław University of Economics and Business https://uew.pl/en/	Public university of economics and business; disciplines relevant to the mining ecosystem: economics, management, logistics, supply-chain management, regional development, public administration; MBA and executive-education programmes	EQF levels 5–8; supply of economists, managers and logistics specialists for the mining industry and its business environment; research on regional economic impacts of mining, energy

		transition and raw-materials policy
Jan Wyzykowski University, Polkowice-Lubin https://ujw.pl/	Private university; the only non-public university in Poland offering a Mining and Geology degree, up to 2025 delivered jointly with KGHM Polska Miedz S.A.; further programmes: mechatronics, management and production engineering, logistics	EQF levels 5–7; direct supply of mining engineers and geologists to KGHM and the Lower Silesian copper-mining district; member of the Lower Silesian Educational Cluster; practical-profile education strongly embedded in industry
WSB Merito University, Wrocław https://www.merito.pl/english/	The largest private university in Lower Silesia; disciplines: management, finance, law, business informatics, engineering management, MBA and executive programmes; holds doctoral-degree-granting rights	EQF levels 5–8; supply of managers, economists and lawyers supporting the business environment of the mining sector; provider of MBA and post-graduate programmes for industrial executives; most-chosen private university in Lower Silesia (2024/25 data)
Academy of Applied Sciences Angelus Silesius Wałbrzych https://www.ans.edu.pl/	Public applied-sciences university (est. 1999); entirely practical-profile curricula: Natural Sciences and Technology (logistics engineering), Social Sciences and Law, Health Sciences; 60+ cooperation agreements with industry	EQF levels 5–7; supply of logistics, administration and technical graduates for industrial and post-mining enterprises in the Wałbrzych basin; supports labour-market needs of the former coal-mining sub-region undergoing economic transition

Lukasiewicz Research Network – PORT Polish Centre for Technology Development Wrocław https://port.lukasiewicz.gov.pl/en/	Leading R&D institute of the Lukasiewicz Network; focus: advanced materials engineering, biotechnology, precision medicine, technology transfer; one of the best-equipped research facilities in Central Europe, operator of the Virtual Research Institute funding programme	Applied R&D and technology transfer to industry; advanced functional materials and process technologies relevant to ore processing and circular-economy applications; commercialisation of research results; participant in European consortia
Lukasiewicz Research Network – Institute of Non-Ferrous Metals, Legnica Branch https://imn.lukasiewicz.gov.pl/en/	Principal R&D and pilot-production unit of IMN; co-located with KGHM Copper Smelter Legnica; specialisation: pyrometallurgy and hydrometallurgy of copper, chemical recycling, processing of secondary raw materials and non-ferrous metal industry residues, production of abrasives and chemical compounds	R&D and pilot-scale metallurgical production for the non-ferrous metals industry; development and implementation of smelting and refining technologies for KGHM (HM Legnica, HM Glogow); recycling and detoxification of industrial waste streams; sole domestic producer of zinc chloride; direct technology partner of KGHM
Poltegor-Institut – Institute of Open-Cast Mining Wrocław https://www.igo.wroc.pl/en/	Leading national R&D institution in surface mining; scope: lignite, crushed-rock aggregates, chemical minerals, binding materials; 13 specialised laboratories; publisher of the quarterly Gornictwo Odkrywkowe (Open-Cast Mining)	Applied R&D in surface-mining technology, mine geology and geotechnics, environmental protection and post-mining land reclamation, and conveyor-belt transport; technical expertise and project services for all Polish open-cast coal mines; multiple Brussels Eureka gold medals for innovation; strategic partner for the lignite sector's energy transition

Institute of Geological Sciences, Polish Academy of Sciences – Research Centre in Wrocław https://www.ing.pan.pl/en/	Academic research unit of the Polish Academy of Sciences; specialisation: petrology, geochemistry, mineralogy, tectonics, magmatic and metamorphic processes, ore deposit genesis, Sudeten geology; internationally recognised research output	Fundamental and applied research on ore deposit geology, mineralogy and geochemistry of mineral raw materials; analysis of ore-forming processes and environmental impacts of mining; expertise in critical-raw-material characterisation and Sudeten mineralisation; co-organiser of GEOplanet Doctoral School
Polish Geological Institute – National Research Institute, Lower Silesian Branch https://www.pgi.gov.pl/en/	Regional unit of the State Geological Survey; activities: geological mapping of the Sudetes and Fore-Sudetic Block, documentation and resource assessment of mineral deposits, hydrogeology, engineering geology, geo-environment monitoring	State geological and hydrogeological survey for Lower Silesia; documentation and annual balancing of mineral-deposit resources (Mineral Resources Balance of Poland); detailed geological mapping of the Sudetes (SMGS 1:25 000); geological databases and National Geological Archive; expert opinions for mining administration and environmental authorities
KGHM CUPRUM Ltd. – R&D Centre, Wrocław https://kgmcuprum.com/en/homepage/	Corporate R&D centre 100% owned by KGHM Polska Miedz S.A. (est. 1967); scope: geology, hydrogeology, geophysics, underground mining, geotechnical and civil engineering, geodesy, mine ventilation, automation, mechanisation, ore beneficiation, tailings and waste management	Dedicated research, design and consulting base for KGHM: support for ore-deposit exploitation, mine infrastructure design, mine-water management, seismic and rock-burst monitoring; 12+ externally funded R&D projects per year in national and European consortia; Horizon Europe participant and EIT RawMaterials member

The mining ecosystem in Lower Silesia is also shaped by educational institutions – secondary schools, technical colleges and vocational schools, as well as vocational training centres dedicated to training staff for the mining and mineral resources industry (Table x). These institutions work closely with

industry, offering curricula tailored to the needs of businesses, often under their patronage and with traineeship and scholarship programmes.

One of the most prominent programmes is Kompetentni w branży - KGHM Polska Miedź funded programme (<https://kghm.com/pl/kariera/dla-uczniow/kompetentni-w-branzy>). It covers 10 schools, including 9 from the Lower Silesia region. In the 2025/2026 school year, the partnership classes had 2345 pupils, and since the programme began in 2018, KGHM has directly employed 552 graduates from these partnership classes.

Table 3.5. Undergraduate Schools and Vocational Training Centres related to mining ecosystem

Institution	Profile/Professions	Role
Zespół Szkół Nr 1 im. prof. Bolesława Krupińskiego, Lubin www.zs1.lubin.pl	- underground mining technician (minerals other than hard coal) - mechanical technician - electrical technician - mechatronics technician - welding technician - underground miner (minerals other than hard coal) - electrician - metalworker	provides workforce on European Qualifications Framework (EQF) level 3-4 under KGHM patronage
Zespół Szkół Elektryczno-Mechanicznych, Legnica www.zsem.legnica.eu	- electrical technician - electronics technician	provides workforce on European Qualifications Framework (EQF) level 4 under KGHM patronage
Zespół Szkół Technicznych i Ogólnokształcących, Legnica zstio.legnica.eu	- metallurgical technician - automation engineer	provides workforce on European Qualifications Framework (EQF) level 3-4 under KGHM patronage
Zespół Szkół Mechanicznych, Bolesławiec zsmbc.eu.org	- underground mining technician	provides workforce on European Qualifications Framework (EQF) level 4 under KGHM patronage
Zespół Szkół Miedziowego Centrum Kształcenia Kadr, Lubin szkoly.mckk.pl	- electrical technician - underground miner (mining of minerals other than hard coal) - underground miner (mining of minerals other than hard coal)	provides workforce on European Qualifications Framework (EQF) level 3-4 under KGHM patronage

	- operator of processing machinery and equipment	
Zespół Szkół im. Narodów Zjednoczonej Europy, Polkowice zs.polkowice.pl	- electrical technician - electrician - electromechanical engineer	provides workforce on European Qualifications Framework (EQF) level 3-4 under KGHM patronage
Zespół Szkół w Chocianowie, Chocianów https://zschocianow.pl/	- mechatronics technology - mechatronics	provides workforce on European Qualifications Framework (EQF) level 3-4 under KGHM patronage
Zespół Szkół im. Jana Wyżykowskiego, Głogów zsw.glogow.pl	- underground mining technician (minerals other than hard coal) - metallurgical technician - automation technician	provides workforce on European Qualifications Framework (EQF) level 4 under KGHM patronage
Zespół Szkół Politechnicznych w Głogowie, politechniczna.glogow.pl	- electrical technician - mechatronics technician - mechanical technician - electrician	provides workforce on European Qualifications Framework (EQF) level 3-4 under KGHM patronage
I Zespół Szkół im. Stanisława Staszica, Wschowa staszicwschowa.edu.pl	- electrical technician	provides workforce on European Qualifications Framework (EQF) level 3-4 under KGHM patronage
Technikum im. Górników i Energetyków Turowa, Zgorzelec https://zszil.pl/	- electrical technician - environmental protection technician - renewable energy systems technician	provides workforce on European Qualifications Framework (EQF) level 4 for lignite mining
Zespół Szkół w Strzegomiu, Strzegom https://zs.strzegom.pl/	- open-cast mining technician	provides workforce on European Qualifications Framework (EQF) level 4 for agglomerate, clays and hard rock mining

Miedziowe Centrum Kształcenia Kadr sp. z o.o. - MCKK (Copper Staff Training Centre Ltd) Lubin https://www.mckk.pl/	- miner (new recruits/specialist) - specialist copper ore miner - supervisory training courses - training courses for mining machinery operators - mining training courses – blasting - mining training courses – shaft work - bricklaying work - many other courses directly and indirectly related to mining ecosystem - vocational training courses and programmes - comprehensive and practical training tailored to the current needs of employers	provides workforce on European Qualifications Framework (EQF) level 3-4 ISO 9001:2015 certification
Branżowe Centrum Umiejętności Górnictwa Rud 4.0 (Specific Skills Centre of Ore Mining 4.0) Lubin https://bcu.mckk.pl/	- education and training, - supporting cooperation between schools and universities with employers, - innovation and development, promoting knowledge and new technologies as well as ecological and digital transformation, - supporting the provision of career guidance for pupils and the professional activation of students, PhD students and graduates. The Copper Personnel Training Centre has secured funding for a project to establish a BCU for the field of underground mining, metal ore processing and mineral resources.	The industry organisation for the BCU Mining 4.0 is the Mining Chamber of Industry and Commerce in Katowice. Partners in the project are: KGHM Polska Miedź S.A. The Mining Chamber of Industry and Commerce The Polish Copper Employers' Association.

Thanks to a strong mining industry and major mining operators, a robust service and manufacturing sector has also developed around the mining centres, comprising some 1,500–2,000 businesses of varying sizes. Among these, companies and SMEs linked to the copper, lignite and aggregates industries play a dominant role.

Table 3.6. The most prominent mining operators, mining equipment manufacturers, technology providers and services for mining providers

Institution	Profile	Role
KGHM Polska Miedź PLC https://kgbm.com/en	Copper (strategic CRM), gold, silver, rhenium, rock salt, molybdenum, nickel sulphate, lead, selenium, sulphuric acid, platinum-group metals; three underground mines in Lower Silesia (Lubin, Rudna, Polkowice-Sieroszowice); smelter-refineries in Legnica and Glogow; wire-rod plant Cedynia.	Largest employer in Lower Silesia (c. 34,000 employees); 2nd largest silver producer worldwide; among the 10 largest copper producers globally; only European producer of ammonium perrenate from own resources; annual refined copper output ~500 kt (2024); backbone of the regional copper-mining ecosystem and anchor for the entire supply chain.
Strzeblowskie Kopalnie Surowców Mineralnych Ltd https://sksm.pl/	Feldspar-quartz raw materials (CRM) and granite from the Strzegom-Sobotka massif; four open-cast quarries covering 100+ ha near Sobotka; products: feldspar-quartz grit and flour for ceramics and glass industries, granite aggregates; production capacity approx. 420,000–450,000 t/y.	Largest Polish producer of feldspar raw materials (85–87% of domestic supply); key supplier to the Polish and European ceramic tile and glass-making industries; exploits Poland's largest critical raw material deposit of the feldspar group in Lower Silesia.
PGE Górnictwo i Energetyka Konwencjonalna PLC Oddział Kopalnia Węgla Brunatnego Turów https://kwbturow.pgegiek.pl/strona-glowna	Lignite (brown coal), clay, and aggregates; large open-pit mine at Bogatynia (Turow basin), operating since 1904; mining area ~50 km ² ; licensed production capacity up to 20 Mt/year; 2024 output approx. 7.2 Mt; mine-mouth power station Turow (1,950 MW).	Sole lignite producer in Lower Silesia; exclusive fuel supplier to Turow Power Station (1,950 MWe), which covers a significant share of regional and national power demand; major employer in the Bogatynia sub-region; subject to ongoing national and EU energy-transition planning; concession extended to 2044 (under legal challenge).

Nowy Łąd Ltd https://www.nowylad.com.pl/en/	Natural gypsum and anhydrite (underground mine at Niwnice, Lwówek Śląski County); the only underground gypsum and anhydrite mine in Poland; products: white Zechstein gypsum, anhydrite flour, semi-hydrate gypsum (beta), dental gypsum grades, anhydrite binder for mining, casting gypsum; geological reserves ~23 Mt.	Only Polish domestic source of natural underground white gypsum and anhydrite; key raw-material supplier to Atlas Group construction-chemistry plants and other building-materials manufacturers; strategic position in national supply of specialist gypsum products; by-product gypsum from Turow power station also processed on site.
ORLEN PLC https://www.orklen.pl/en	Natural gas and crude oil (upstream); onshore gas fields in Lower Silesia and adjacent regions: Zuchlow and Borzecin (Lower Silesia); integrated energy and fuel company (formerly PGNiG upstream assets merged with ORLEN in 2022); total domestic gas production ~3.4 billion m³/year.	Domestic hydrocarbon production supporting Poland's energy security (~20% of national gas demand from own resources); Lower Silesian gas fields contribute to the regional energy supply; operators maintain upstream infrastructure and geological services for the region; royalty payments supporting local municipalities.
Mine Master Ltd https://www.minemaster.eu	Underground mining machinery manufacturer (est. 1972, Wilkow near Zlotoryja, Lower Silesia); specialisation: low-profile and ultra-low-profile drilling rigs (Face Master series), roof bolters (Roof Master series), scalers; 1,300+ machines sold over 40 years; facilities expanded in Wilkow.	Primary supplier of drill rigs and bolters to KGHM copper mines (Lubin, Rudna, Polkowice-Sieroszowice); machines adapted to the unique flat-seam, low-height conditions of the Legnica-Glogow Copper Belt; significant export activity (Kazakhstan, Germany, Peru and others); key innovation partner for KGHM's underground mechanisation programme.

KGHM ZANAM PLC https://www.kghmzanam.com/en/	Mining machinery and equipment manufacturer (Polkowice, Lower Silesia; KGHM Group subsidiary); products: underground loaders (LK series), mine trucks, belt conveyors and conveyor systems, crushing sets, jaw and impact crushers, castings (steel and iron), large welded steel structures; EPC services for mine investments.	One of the largest Polish manufacturers of underground mining equipment; primary machine and conveyor supplier to KGHM mines and PeBeKa (c. 550+ machines in KGHM fleet); also exports to Germany (K+S AG) and international markets; backbone of KGHM Group's in-house mechanisation and maintenance capability.
Engram Grupa Energetyczna https://engram.com.pl/	Electrical installation contractor and industrial automation company (Marciszow, Lower Silesia; est. 1992); specialisation: power electrical installations, prefabrication of electrical switchboards and distribution panels, industrial automation systems; operates primarily in mining, construction and energy sectors.	Specialist electrical-installation and automation contractor for Polish mining and energy companies, including KGHM and PGE GiEK (e.g. restoration of excavator K-41 at KWB Beltchatow); key supplier of mine electrical infrastructure in the Lower Silesian copper-mining basin; partner to Wroclaw University of Science and Technology.
PeBeKa PLC https://pebeka.pl/en	Specialist underground construction company (Lubin, Lower Silesia; KGHM Group; est. 1960s); services: shaft sinking and reconstruction, roadway and chamber drilage, tunnel construction (road, rail, hydrotechnical), geological and piezometric drilling, blasting, underground assembly works, infrastructural construction.	Main contractor for mine shafts in the Legnica-Glogow Copper Belt (30 shafts, 30+ km combined depth); indispensable for KGHM's mine development and deepening programme; international tunnel contractor on 5 continents (metro, road, rail); unique rock-mass freezing technology for shaft sinking in waterlogged strata.

SPECJALISTYCZNE PRZEDSIĘBIORSTWO BUDOWY KOPALŃ "SERWIS" Ltd Polkowice	Specialist underground mine-construction and maintenance company (Polkowice, Lower Silesia); services: underground mining works (roadway drivage, underground construction), machine installation and assembly, pipeline and distribution-network construction; c. 140 employees.	Specialist SME contractor for underground works and equipment installation in KGHM copper mines; part of the extensive SME supplier ecosystem serving the Legnica-Glogow Copper Belt; provides flexible construction and maintenance capacity complementing PeBeKa's larger-scale activities.
MT-Silesia https://mt-silesia.com/	- mobile automation and control systems for mining machinery - implementation of cloud-based solutions for real-time monitoring of underground machinery operating parameters - functional safety – life and property protection systems - safety audits and engineering - maintenance and service support - servicing of mechanical and electrical components - distribution of specialised industrial automation components resistant to extreme dust, moisture and vibrations encountered in mines	A leading provider of engineering solutions for the mining and tunnel construction sectors. The company specialises in machine automation and functional safety systems. It supplies technologies that enable mines to optimise extraction processes and improve health and safety standards in challenging underground and open-cast conditions.
ABB Ltd https://new.abb.com/mining	- comprehensive drives, motors and generators for mines, - digital control and monitoring systems (ABB Ability), - strategic partnerships with national and international mining companies, - and the implementation of modernisation and turnkey projects that enhance safety and operational efficiency.	A leading supplier of technology and solutions to the Polish mining industry, offering comprehensive automation, drive and motor systems for mines and working with the country's leading mining companies (KGHM PM S.A., PGG).

KGHM METRACO PLC https://metraco.pl/en/home/	- the collection of copper scrap and copper-bearing materials for the copper smelters of KGHM PM S.A. - production of road aggregates from copper-bearing waste generated at the Głogów Copper Smelter and the Legnica Copper Smelter - production of ammonium rhenate and metallic rhenium from acidic industrial effluent originating from the Legnica Copper Smelter	The largest buyer of copper scrap in Poland and Central and Eastern Europe.
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As part of the EMRIE project, a project stakeholder group was established, to which the most important actors operating in the region in the area of mining and processing of critical raw materials were invited.

Table 3.7. EMRIE Stakeholders Group

Institution	Profile	Role
KGHM Polska Miedź PLC https://kgbm.com/en	The Leader in the mining industry. As a modern and global organisation it influences sustainable development worldwide. The company operates on 3 continents. Mining Projects are conducted in: Europe, North America and South America. Number of employees: 34 000	- extraction and processing of valuable natural resources (copper, precious metals, rhenium, molybdenum, nickel and palladium) - resources of copper ore, controlled by KGHM (22,7 million tones) - Europe's largest copper ore deposits (S-W Poland)
KGHM Cuprum Ltd. - Research & Development Centre https://kgmcuprum.com/en/homepage/	KGHM Cuprum Ltd. Research & Development Centre main activity is the support of a copper giant KGHM Polska Miedz S.A. in the implementation of the strategy, expanding its resource base, diversification of the activity, as well as in creating development and innovative technological solutions.	- mining and geo-engineering - detailed design for industrial facilities - geology and hydrogeology - environmental protection - optimisation of mineral processing operations and metal recovery technologies - energy technologies

KGHM ZANAM PLC https://www.kghmzanam.com/en/	KGHM ZANAM S.A. is one of the largest Polish manufacturers of machinery and equipment for the mining sector, forming a key part of the KGHM Polska Miedź S.A. Group and supporting its core technological operations. The company plays a strategic role in ensuring the continuity, safety and efficiency of underground mining processes.	- manufacture of mining machinery and equipment: loaders (LHD), haulage trucks, drilling and bolting rigs, auxiliary and blasting vehicles, belt conveyor systems, crushers, steel structures, steel and cast-iron castings - comprehensive industrial services: EPC investment project execution, maintenance and overhaul services, underground mining services (preparatory works, blasting, underground transport, conveyor transport), warranty and post-warranty service of mining machinery, transport and logistics services
Poltegor-Instytut – Institute of Open-Cast Mining Wrocław https://www.igo.wroc.pl/en/	Poltegor-Institute is a research and development unit which competences covers a whole range of problems related to management, exploration, exploitation and reclamation of raw materials extracted with an opencast method, especially lignite and natural stone.	- implementation of projects in collaboration with industrial partners, research institutions and public authorities - opencast mining - post-mining land transformation - environmental restoration and monitoring - circular economy (utilisation of post-mining waste) - implementation of technologies for the raw materials and energy sectors
The Employer's Organisation of Polish Copper https://pracodawcy.pl/	The Employer's Organisation of Polish Copper was established in 1996 by KGHM Polska Miedź SA. It is an independent and not-for-profit	- acting on behalf of members and representing their interests in relation to the protection of

	regional employer's organisation whose goal is to represent and protect the employer's interest. It brings together 115 employers from Lower Silesia, employing over 35,000 staff. In addition to the founding members, the Association's members also include small and medium-sized enterprises with no capital ties to the KGHM Group.	intellectual and legal property, - working to foster and maintain social harmony in industrial relations, - supporting the Union's members in negotiating collective labour agreements and other collective agreements, - initiating, negotiating and concluding multi-employer collective agreements on behalf of employers affiliated to the Union, - influencing the shaping of social policy and legislation concerning employers' interests, - undertaking initiatives and actions aimed at raising the level of education, qualifications and knowledge of employers, and facilitating the exchange of experiences - submitting legislative proposals and opinions to bodies with legislative powers regarding legal acts concerning labour relations and economic policy - working to promote the development of the local community
Polish Aggregates Producers Association https://www.kruszpol.pl/	One of the largest and oldest organisations in the mining industry in Poland (since 1993). The only organisation representing aggregate producers in Poland. It represents 46 entities – mainly aggregate producers – operating in 140 different locations. It has been a	- cooperating with government, local authority and mining bodies - protecting the interests of producers and mining companies in the face of any legal changes and requirements regarding the quality of aggregates

	member of Aggregates Europe since 2025.	- ensuring the supply of rock materials - promoting the use of local raw material resources, including recycled aggregates and industrial aggregates - promoting modern techniques and technologies in the rock raw materials extraction industry - coordinating the activities of aggregate producers and employers
Association of Mining Engineers and Technicians - Wrocław Branch https://www.zositg.wroclaw.pl/#menu	A scientific and technical association bringing together engineers and technicians specialising in mining, geology and related fields associated with the mining industry.	- shaping public opinion and perceptions regarding the mining industry - promoting technical education and culture - improving the training system for technical staff in the mining and geological sectors - fostering professional ethics, preserving mining traditions and protecting technical heritage
District Mining Office in Wrocław https://www.wug.gov.pl/kontakt/oug_we_wroclawiu	The Director of the District Mining Office in Wrocław is the mining supervisory authority with jurisdiction for Lower Silesia.	- inspecting mining establishments and geological works - issuing administrative decisions concerning the operation of mining establishments - supervising compliance with occupational safety regulations - analysing the causes of accidents, near-misses and natural deaths in the mining industry - cooperating with public administration

		- measures to limit the impact of mining activities on people and the environment - measures to prevent the illegal extraction of minerals
Omya Ltd https://www.omya.com/en	Omya is an international industrial group headquartered in Switzerland, which has been in continuous operation since 1884. The company is one of the world's leading producers of industrial minerals, in particular calcium carbonate- and dolomite-based fillers and pigments, as well as a global distributor of speciality materials and functional additives. Omya employs scientists and technical experts in around 50 countries and operates 17 specialised laboratories.	- Omya Speciality Materials – the manufacture and sale of specialist minerals, pigments, binders, functional additives and ingredients for the paper, construction, chemical, food, pharmaceutical, feed and plastics industries - Omya Performance Polymer Distribution – global distribution of high-performance polymers, engineering plastics, elastomers and additives for plastics and rubber
Holcim Polska PLC https://www.holcim.pl/	Holcim Polska SA is part of the global Holcim Group, headquartered in Zug, Switzerland. Holcim Polska SA is one of Poland's largest manufacturers of building materials.	- operates an extensive network of cement plants, aggregate quarries, concrete plants, insulation material factories and construction chemicals plants - supports the transition of the construction and industrial sectors towards a low-carbon economy - implements its climate transition strategy through the development of a circular economy, the use of recycled materials, the development of low-carbon products such as ECOPlanet cement and ECOPact concrete, and investments in solutions

		that support climate neutrality
Magnezyty Grochów PLC https://magnezyty.com.pl/en/home/	The company specialises in the production of high-quality magnesium raw materials.	- offers products for use in the construction, chemical and metallurgical industries
Polish Geological Institute – National Research Institute, Lower Silesian Branch https://www.pgi.gov.pl/en/	The leading scientific and research institution in Poland, performing key functions of the State Geological Service and the State Hydrogeological Service. It is responsible for the country's raw materials security, the protection of groundwater, the assessment of natural hazards and the supervision of geological management.	- comprehensive studies of the geological structure of Poland - geological, geoenvironmental and hydrogeological mapping - evaluation of national minerals resources potential - evaluation of quality and resources of groundwaters - monitoring and analysis of geological issues of the natural environment - acquisition, storage, processing and dissemination of geological and geoenvironmental information of Poland - geological consultancy services for central and local government - cooperation with geological surveys and organisations involved in geological research in the other countries - editing and publishing maps, atlases, periodicals and series of publications in geology
Mineral and Energy Economy Research Institute of the Polish Academy of Sciences https://min-pan.krakow.pl/en/	A research institute of the Polish Academy of Sciences specialising in research into the management of mineral resources.	Conducting interdisciplinary and comprehensive research in the following fields: - mining

		- energy (renewable energy sources and geothermal energy) - geophysics - applied geology - environmental engineering and protection - chemical technology and materials engineering
Strzeblowskie Kopalnie Surowców Skalnych Ltd https://sksm.pl/	A leader in the extraction and production of feldspar raw materials and a major producer of quartz powder and mineral aggregates in Poland.	- extraction and processing of feldspar and quartz raw materials - production of quartz and mineral products - production of granite aggregates for the construction and infrastructure sectors - quality management and environmental protection - cooperation with local authorities and communities - educational activities and promotion of mining traditions
Polish Association of Mineral Asset Valuation https://polval.org.pl/	The Polish Association of Mineral Asset Valuation is a trade organisation dedicated to setting standards, certification and education in the field of professional valuation of mineral and anthropogenic deposits in Poland. It represents the interests of the sector in dealings with central and local government bodies, the business community and civil society organisations.	- reporting on the inventory of mineral and anthropogenic deposits - valuation of mineral and anthropogenic deposits based on the Polish Code for the Valuation of Mineral Deposits - training in the inventory of deposits and the valuation of mineral and anthropogenic deposits - organising conferences, seminars and workshops, and participating in meetings of specialists in the field of resource

		inventory and deposit valuation - participation in national and international projects concerning resource inventory, deposit valuation and mineral resource management - awarding Certificates of Competent Geologist and Mineral Deposit Valuator, and applying to the European Federation of Geologists for the title of Eurogeologist
The Łukasiewicz Research Network – Institute of Non-Ferrous Metals https://imn.lukasiewicz.gov.pl/en/	A research unit forming part of the Łukasiewicz Research Network, comprising a total of 22 research institutes, which has been working on behalf of the non-ferrous metals industry for over 70 years.	- research and development work focused on the development of new materials and technologies - optimisation of industrial processes, modernisation of production lines, equipment design, measurement and analytical services - research covers all stages of the production and processing of non-ferrous metals, from ore processing to pyrometallurgical and hydrometallurgical technologies, materials manufacturing technologies, post-production waste recycling and environmental protection processes.

4. Funding & Collaboration Landscape

Table 4.1. Financial instruments at the EU level

Program / Instrument	Purpose and scope of support	Beneficiaries / Notes
„Connecting Europe”	Modernization of transport, railways and alternative fuel infrastructure.	Enterprises in the transport and alternative fuels sectors.
LIFE + Sub-program: Circular Economy and Quality of Life	Environmental protection, transition to clean energy, adaptation to climate change, testing innovative pro-environmental technologies.	Individuals conducting business activities and legal entities registered in the EU. Funding is available for up to 60% of eligible costs, and for environmental projects, up to 75% (maximum 95%).
Horizon Europe	Green transformation, research, innovation, and commercialization of green technologies. Cluster 5 (climate, energy, mobility) and Cluster 6 (natural resources, circular economy).	Scientific units, enterprises, consortia.
Innovation Found	Demonstration of innovative low-emission technologies.	Entities implementing technologies supporting climate neutrality.
InvestEU	Financing investments with a higher risk profile through EU guarantees.	Successor to the Juncker Plan; repayable support.
Joint Transition Fund	Support for regions affected by the transition to a climate-neutral economy.	Public sector, enterprises in transition regions.
EENergy	Improved energy efficiency (by at least 5%).	SMEs; grant of €10,000

Table 4.2. National support instruments

Action/Programme	Goal and area of support	Max. EU Funding
FENG 01.01 SMART Path	R&D work, implementation of innovations, digitalization and greening of enterprises.	80%
FENG 01.02 Digital Transformation Fund	Loans for the transformation towards Industry 4.0 and the circular economy.	100%

FENG 02.17 Development of cluster offers	Strengthening cluster coordinators in the field of R&D&I services, including circular economy and Industry 4.0.	70%
FENG 02.32 Technology Loan	Implementing new technologies and introducing innovative products to the market.	70%
FENG 05.01 Critical Technologies	Development of digital, clean technologies and biotechnology (in accordance with the STEP regulation).	100%
FENIKS (Recycling)	Construction and modernization of installations for the recovery and recycling of municipal and industrial waste.	Depends of the project
FENIKS (Circular economy optimization)	Rationalizing resource consumption, reducing waste, recycling and closing the water cycle in production.	Depends of the project
FENIKS (Educational and informational activities)	Raising public environmental awareness in the field of circular economy, waste prevention and waste management hierarchy.	85%
National Recovery and Resilience Plan	Green transformation of the economy, investments in the implementation of environmental technologies (CE) and modernization of installations to improve energy efficiency.	Subsidies and loans

Table 4.3. Financial Instruments at the regional level (Lower Silesia)

Actions (FEDS 2021-2027)	Goal and type of support	Area of application
FEDS.01.02 Innovative enterprises	Grant	Investments in SME research infrastructure, research activities and innovation in SMEs.
FEDS.01.05 Financial Instruments for SMEs	Development loan	Investments that limit the impact on the environment, circular economy technologies, eco-innovations.

FEDS.02.03 Financial instruments for energy efficiency	Eco loan	Buildings energy modernization, replacement of heat sources, renewable energy sources with energy storage
FEDS.02.04 Innovations in renewable energy	Grant	Construction and expansion of installations generating electricity and/or heat from renewable energy sources, construction of energy storage facilities for renewable energy sources.
FEDS.02.05 Financial instruments for renewable energy	renewable energy loan	Construction and expansion of installations generating electricity and/or heat from renewable energy sources, construction of energy storage facilities for renewable energy sources.
FEDS.09.04 Economic transformation	Grant	Energy efficiency projects in SMEs (so-called "green" SME investments)
FEDS.09.05 Environmental transformation	Grant	Renewable energy projects – including solar, biomass and other types of renewable energy (including geothermal energy), redevelopment of industrial areas and remediation of contaminated land.

5. Circularity & Resources Efficiency

The first document to comprehensively address the topic of the circular economy (CE) in Poland was the "Roadmap for the Transformation towards a Circular Economy," adopted by the Council of Ministers in 2019. The document defined the circular economy as an economic development model in which, while maintaining efficiency, the following basic assumptions are met: a) the added value of raw materials/resources, materials, and products is maximized, or b) the amount of waste generated is minimized, and the resulting waste is managed in accordance with the waste management hierarchy.

The document implemented the main strategic and operational assumptions set out in the 2015 EC Communication "Closing the Loop - An EU Action Plan for the Circular Economy." Chapter I "Sustainable Industrial Production" highlighted the important role of industry in the Polish economy and new development opportunities. It was also emphasized that there is significant potential for improvement in Poland regarding industrial waste management, particularly from mining and quarrying activities. According to data from the Central Statistical Office ("Environmental Protection 2018"), presented in the roadmap, 126 million tons of waste were generated in Poland in 2017, of which only a small amount was municipal waste (12.0 million tons). The main sources of waste in 2017, as in previous years, were mining and quarrying, industrial processing, and energy generation and supply. The roadmap identifies specific actions that should be undertaken, including conducting a feasibility study on the creation of a dedicated platform for secondary raw materials and conducting a national analysis of the potential for opening and utilizing waste dumps from the processing and mining industries, as well as analyzing the morphological composition of mining waste and the potential for its use in specific sectors of Polish industry.

Unfortunately, a report prepared in 2025 by the Supreme Audit Office, analyzing the scale of implementation and execution of the roadmap provisions for 2019-2023, clearly indicates that most of the actions that should have already been taken have either not been undertaken or are still in progress. This demonstrates that, in parallel with the actions undertaken by state institutions, companies operating in the extraction and processing of natural resources, including critical ones, should primarily engage in the circular economy process by implementing their own climate and sustainable development policies that reduce waste production and open up numerous opportunities for its reuse.

As already mentioned, the Lower Silesian Voivodeship is one of the most important mining regions in Poland. A characteristic feature of the mining ecosystem in Lower Silesia is the presence of one large enterprise, with an international reach and significant importance to the national economy, operating in the extraction, processing, and recycling of metallic raw materials, as well as numerous smaller enterprises extracting and processing rock raw materials. This division has a key impact on the development and implementation of circular economy solutions in the raw materials industry in the region.

KGHM Polska Miedź PLC has been implementing circular economy (CE) solutions for years, supporting research in mining, processing, and recycling consistent with internationally accepted CE solutions, and supporting solutions that increase the efficiency of raw material processing. Many small and medium-sized enterprises mining rock in the region lack the potential to invest in innovation and research, continually modernize their machinery, and implement solutions that increase the efficiency of the mining and processing. This division also impacts the availability of data and the possibility of further analysis in the context of examining the scale of implementation of CE solutions in the country and region. In the area of metallic minerals mining in Lower Silesia, dominated by KGHM Polska Miedź PLC, an internationally operating listed company, we have knowledge about the current state of mining, waste generated by the company's operations, and the scale of its reuse. For companies operating in the mining and rock processing sector, we must rely on data from annual reports prepared by the National Statistical Office, which detail national data and, where appropriate, regional

breakdowns. This is particularly important in the context of researching the potential of secondary raw materials from mining dumps.

1) The principal material flows

In the production of critical raw materials, a key player in Lower Silesia is KGHM Polska Miedź PLC. One of the most important companies in Europe producing the critical raw material copper. KGHM Polska Miedź PLC is the Polish arm of the international KGHM Polska Miedź PLC group, which also includes additional segments: KGHM International LTD. and Sierra Gorda S.C.M.

KGHM Polska Miedź PLC, headquartered in Lubin, operates exclusively in Lower Silesia, specializing in mining and smelting metals—copper, silver, and gold. Mining is conducted at three mines: Polkowice-Sieroszowice, Rudna, and Lubin. In 2025, copper ore production reached 202.1 thousand tonnes, 177.9 thousand tonnes, and 72.4 thousand tonnes, respectively. The mine's current production capacity is 12.1 million tonnes, 11.5 million tonnes, and 8.3 million tonnes of ore annually. KGHM Polska Miedź PLC also conducts extensive smelting operations at three smelters – Głogów, Legnica, and the Cedynia rolling mill. In 2025, each smelter produced 448.6 thousand tonnes and 122.3 thousand tonnes of electrolytic copper, 262.1 thousand tonnes of copper wire rod, and 17.8 thousand tonnes of oxygen-free copper wire.

KGHM Polska Miedź PLC's production is a fully integrated production process, in which the end product of one technological phase serves as the input (semi-finished product) used in the next phase. KGHM Polska Miedź PLC's mining operations comprise the three mining divisions referred to in the paragraph above. In the next phase, the Ore Enrichment Plant Branch prepares concentrate for smelters, and the Hydrotechnical Plant Branch is responsible for the storage and management of waste generated in the copper ore enrichment process.

The copper ore extraction technology in all three mines is based on room-and-pillar systems, using blasting to excavate the ore. All enrichment plants employ the same operations and unit processes; however, due to the varying lithological and mineralogical composition of the ores from individual mines, the process flows differ. The processing technologies employed include the following unit operations: screening and crushing, grinding and classification, flotation, and concentrate dewatering. Flotation enrichment produces concentrate with an average copper content of approximately 22-23%, as well as flotation tailings. The concentrate with the highest copper content is produced in the Rudna Ore Enrichment Plant (26.1%), and the lowest in the Lubin Ore Enrichment Plant (13.7%). The Polkowice Ore Enrichment Plant produces concentrate with a copper content of 24.8%. The dried concentrate, with a moisture content of approximately 8.7%, is transported by rail to the Legnica Copper Smelter and Refinery in Legnica, and the Głogów I and Głogów II Copper Smelters and Refineries in Głogów.

Float tailings, in suspension, are transported via pipelines to the "Żelazny Most" Mining Waste Disposal Facility, where the solid phase sediments, and the clarified water is collected and returned to the processing plants. The storage facility also serves as a retention reservoir for excess mine and process water in the pipeline. Excess water is discharged hydrotechnically into the Oder River.

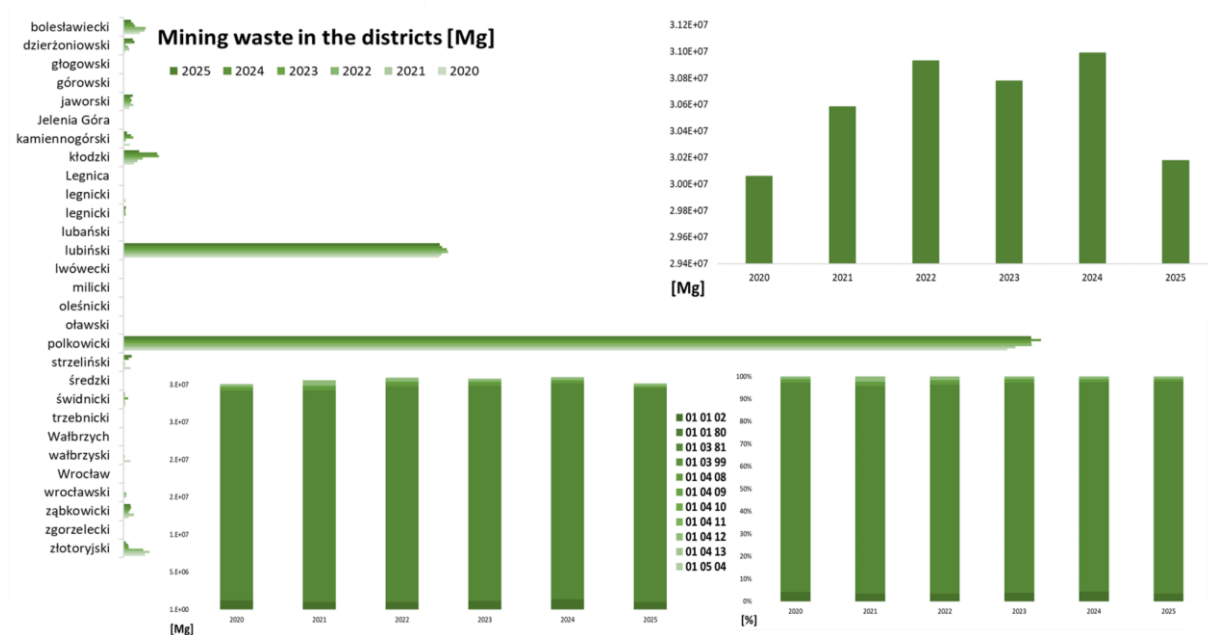
KGHM Polska Miedź PLC holds the Copper Mark (Responsibly Produced Copper) in all three of its smelting plants. Receiving this distinction confirms that KGHM plants conduct efficient copper

production in accordance with the highest standards and are implementing the UN's 2030 Sustainable Development Goals (SDGs).

2) Mine waste valorisation and secondary resource flows

In 2024, a total of nearly 103 million tons of waste was generated in Poland (a decrease of approximately 23 million tons compared to 2017), including 34.7 million tons in the Lower Silesian Voivodeship. Of this total, as much as 28.9 million tons were waste from the flotation enrichment of non-ferrous metal ores, an additional over 1.1 million were waste from the extraction of minerals other than metal ores, and nearly 1.3 million were mixtures of fly ash and solid waste from calcium-based flue gas desulfurization methods. Furthermore, Lower Silesia is also a leader in the country in terms of accumulated waste. As of the end of 2024, over 710 million tons of waste (over 38.5% of the waste accumulated in Poland) were stored in the Lower Silesian Voivodeship, including over 673 million tons of waste from the flotation enrichment of non-ferrous metal ores. The storage and reuse of mining waste is therefore one of the strategic challenges facing the voivodeship. As with the production of mineral resources in the region, including critical minerals, the main "host" of the Lower Silesian waste base is KGHM Polska Miedź PLC. However, the potential for recovering critical raw materials from heaps associated with former metal ore mining in the voivodeship and potentially from post-mining heaps created by the Lower Silesian rock mineral industry should not be overlooked.

As mentioned above, KGHM Polska Miedź PLC generates the largest amount of mining waste in Lower Silesia during the flotation enrichment of non-ferrous metal ores (01 03 81) at the Ore Enrichment Plants (Lubin, Polkowice, and Rudna). Their primary role is to maximize metal yields and produce concentrates meeting the quality parameters required by smelters at the lowest possible cost. All ore extracted from the KGHM Polska Miedź PLC Mining Plants is directed to the Ore Enrichment Plant. The same operations and unit processes are used in all enrichment plants, including screening, crushing, grinding, classification, flotation, thickening, filtration, and drying. Copper ores are processed, the main operation of which is enrichment, which results in a concentrate with a copper content of 18-32% Cu, enabling its metallurgical processing, and an aqueous suspension of flotation tailings (010381) with a content of 0.17-0.27% Cu (Malewski et al. 2008). The amount of tailings oscillates around 28 million Mg/year, which constitutes approximately 93% of the mining tailings produced in Lower Silesia.



Pict. 5.2.1. Quantitative analysis of mining waste in Lower Silesia
Own study based on data from BDO (2026)

Mining waste is recovered and disposed of in installations located on the premises of waste-producing enterprises (approx. 95%). The largest volume of waste in Lower Silesia, coded 01 03 81 (98%), is recovered and disposed of by the Żelazny Most Hydrotechnical Plant, owned by KGHM Polska Miedź PLC, at the Żelazny Most Mining Waste Disposal Facility (Fig. 5.1.2).



Pict. 5.2.2. View of the Żelazny Most Tailings Storage Facility of KGHM Polska Miedź PLC
Source: Google Earth (2026)

This waste is subjected to processes described in the BDO as R5 (recycling or recovery of other inorganic materials) and D5 (depositing in landfills in a purposefully designed manner (e.g., placing in sealed, separate chambers, covered and isolated from each other and from the environment, etc.)). The coarse fraction of this waste is used to build dams (25%), and the finest fractions are used to seal the bottom of the facility (50%) by transporting waste from the Polkowice Ore Enrichment Plant

through a selective hydrotransport system into the landfill basin. Sealing the basin is carried out to eliminate the infiltration of mineralized supernatant waters into the landfill substrate – if these measures are not taken, this process could cause large-scale contamination of usable groundwater levels and adverse changes in soil water conditions. The remaining waste is stored there (Malewski et al. 2008). The Żelazny Most tailings storage facility is Europe's largest tailings storage facility, operating since 1977. Its area covers over 2,000 hectares, its volume is 950 million m³, and its dams are 20 km long and 54 to 76 m high. The reservoir and its surroundings are monitored, including: precipitation measurements, substances and indicator parameters in surface, leachate, and groundwater, groundwater level measurements in observation wells, surface subsidence monitoring in the reservoir, leachate volume measurements, seismic monitoring, atmospheric air, soil, and plant monitoring, animal health monitoring, and noise monitoring.



Pict. 5.2.3. Mining waste management in Lower Silesia
Own study based on data from BDO (2026)

Waste management at KGHM Polska Miedź PLC aims to utilize waste from technological processes at every stage of production in order to maximize the recovery of copper and associated metals while simultaneously limiting the impact on the natural environment. These activities allow, among other things, for:

- recovery of metals from dust and sludge generated in dust abatement systems,
- recovery of copper from copper-rich suspension slag,
- transfer of decoppered cast slag and for the production of construction aggregates, and decoppered granulated slag for the production of abrasives,
- transfer of spent copper-coated linings to the production of copper concentrate, and uncoppered linings to external customers for the production of refractory materials,
- complete internal recycling of all slags from converters and melting furnaces as feedstock for pyrometallurgical processes,
- use of electrolyte withdrawn from electrorefining circuits for the production of copper sulfate and nickel sulfate, and use of decoppered electrolyte to prepare working electrolyte used for the production of cathode copper,
- recycling of spent anodes to pyrometallurgical processes copper production,

- h) use of anode sludge from the electrorefining process as a raw material for the production of precious metals,
- i) recovery of metals from sludge from the converter gas treatment plant in the lead production plant,
- j) recovery of selenium from the circulating water of the wet gas dedusting unit in the precious metals plant,
- k) recovery of silver from the spent electrolyte.

3) Urban mining

As part of its research, the Polish Geological Institute - National Research Institute conducted an inventory of post-mining and post-metallurgical facilities in Poland, where over 1 billion cubic meters of industrial waste had been deposited (<https://geologia.pgi.gov.pl/haldy/>, 2026). The aim of this inventory was to identify potential reuse options for waste deposited in old mine dumps, mining and processing waste dumps, and post-mining settling ponds. These facilities constitute anthropogenic mineral deposits from which valuable raw materials, including critical minerals and rare earth elements, can be extracted. However, their exploitation faces technological, economic, environmental, health, and legal barriers. The main technological limitations include low concentrations of critical elements, the dispersion and variability of material within the facilities, and the lack of developed cost-effective industrial methods for their recovery. However, the data collected in the HALDY database provides valuable economic information for potential future investors. In Lower Silesia, where mining and processing have developed in the recent past, 788 objects have been inventoried, including spoil heaps, industrial settling ponds, and landfills. These objects are remnants of mining operations for barite and fluorite, sulfur, hard and brown coal, polymetallic ores, uranium, iron, copper, arsenic, tin, and cobalt (Sroga et al. 2018). Waste heaps from copper ore mining (Wałbrzych, Nowy Kościół, Złotoryja region) and polymetallic ore mining (Kowary, Krobica) contain flotation tailings and smelter slag, which may contain elements of strategic importance for modern technologies (e.g., cobalt, gallium, germanium, indium, and even rare earth elements - REE), whose recovery using previous methods was unprofitable or technologically impossible. These objects have significant potential for raw material recovery within urban mining.

In response to the needs of the labor market, Wrocław University of Science and Technology has established an inter-faculty Master's degree program in Urban Mining, educating specialists with knowledge and skills in areas such as identifying anthropogenic waste deposits and assessing their resource potential, technologies for recovering raw materials from waste while maintaining the zero-waste principle, and managing the anthropogenic waste processing process. We recommend this program as a Good Practice in raw materials education (Pict. 5.1.4.).

Semestr 1	Semestr 2	Semestr 3	Semestr 4
Urban mining-utility of waste	Methods of waste streams identification and assessing the raw material potential	Physical and physicochemical methods of waste processing	Graduate laboratory
Basics of processing methods	Identification and assessment of environmental aspects		
Biological factors in industry – fundamentals	Circularity assessment tools		
Statistical methods in waste management	Techniques and methods of exploitation anthropogenic deposits	Chemical and biological methods of waste processing	
Humanities and management course	ESG reporting		
Block I (elective course)	Process engineering	Instrumental methods in biomonitoring and analysis of products	Project Feasibility Study
Block II (elective course)			
Formal, legal and economic aspects of anthropogenic deposits exploitation	Analysis of circular economy in processing processes		
Foreign language I	Foreign language II	Occupational Health and Safety in waste management	



Pict. 5.3.1. Urban Mining course curriculum

<https://wggg.pwr.edu.pl/kandydaci/studia-ii-stopnia/urban-mining, 2026>

4) Process efficiency

The mining and processing of copper, the only critical raw material found in Lower Silesia, is conducted within a single capital group, KGHM Polska Miedź PLC. The company's operations include activities aimed at increasing the efficiency of the mining and processing process. These activities are conducted in collaboration with regional universities and enterprises, which together form the mining ecosystem in Lower Silesia. Activities aimed at increasing the efficiency of the mining process while meeting The Copper Mark (Responsibly Produced Copper) standards should be divided into five areas: decarbonization of production, energy transition, reduction of the carbon footprint, reduction of pollutant emissions, and waste management.

As part of its decarbonization efforts, the company plans to reduce indirect emissions, i.e., emissions related to electricity use, by 2030. The intermediate target adopted by the company in its Climate Policy (a 30% reduction in direct and indirect emissions) is lower than the science-based emissions reduction scenario consistent with limiting global warming to 1.5°C, which is 42% by 2030. The adopted target is lower because reducing emissions in line with the science-based target for energy-intensive businesses in countries where the national energy mix is based on fossil fuels is not feasible without a radical change in the national energy mix. The company plans to implement decarbonization initiatives across all areas of its operations, with particular emphasis on reducing emissions resulting from the use of its own concentrates in metallurgical processes. The main direction in this area will be a shift away from electricity obtained from the market and generated from fossil fuels towards the increasing use of its own low-emission and zero-emission sources of electricity and heat. The development of its own renewable energy sources will include the construction or acquisition of renewable energy installations, such as photovoltaic power plants and wind farms. The electricity generated in these installations will be used 100% in the company's Main Process Line processes.

As part of its energy transformation, the company plans to generate at least 50% (approximately 220 MW) of its contracted electricity capacity from its own low- and zero-emission sources by 2030.

As part of its efforts to reduce the carbon footprint of KGHM Polska Miedź PLC products, an environmental impact and carbon footprint analysis of the company's key products was conducted in 2021, based on an LCA analysis. Additionally, environmental performance declarations were prepared for selected products. The analysis showed that, compared to industry averages, the company's key products have a lower carbon footprint.

Copper mining is also conducted with steadily decreasing emissions, despite increasing production. KGHM Polska Miedź PLC's dust emissions from mining emissions decreased by 71% between 2010 and 2024. During the same period, dust emissions from the company's smelting operations decreased by 91%. Sulfur emissions decreased by 81% and arsenic by 86%.

6. Enabling Conditions

1) Logistics

Road infrastructure: Lower Silesia occupies a strategic place on Europe's transport map, serving as a key transportation hub connecting the west of the continent with the east and the north with the south. The region is intersected by major trans-European corridors, making it highly attractive to the mining, industrial, and logistics sectors. It boasts one of the longest and most modern road networks in Poland, which is constantly being expanded to increase transport accessibility. Of key importance are:

- **A4 motorway (E40):** It forms part of the longest international road in Europe, connecting France (Calais) with Kazakhstan. It is the region's main east-west transport axis.
- **S3 expressway (E65):** A key north-south route, connecting Scandinavian economic centers (Malmö) with southern Europe (Greece). It provides a direct connection between the region and Baltic ports.
- **TEN-T Network:** One of the branches of the Baltic-Adriatic Corridor of the TEN-T Core Network runs through the region, encompassing the A4, A8, and A18 motorways, as well as the S5 and S8 expressways.

The Lower Silesian Voivodeship's road network consists of:

- 437 km of expressways and motorways,
- 1,385 km of national roads,
- 2,384 km of provincial roads,
- 7,922 km of district roads,
- 9,660 km of municipal roads.

Rail Infrastructure: Lower Silesia boasts the densest railway network in Poland. According to 2024 data, the network density is 9.19 km/100 km², significantly exceeding the national average (6.2 km/100 km²).

- **Length of active lines:** 1,832.52 km of standard-gauge railway lines.
- **Technical parameters:** The main international main lines within the TEN-T network are designed for trains with an axle load of 221 kN, which is critical for the transport of heavy mineral and aggregate cargoes. Most of the remaining network has been adapted to the 196 kN standard.

- **Strategic importance:** The railway network provides direct connections with Germany, the Czech Republic, and Ukraine, as well as with Polish seaports, facilitating the export of copper products and rock raw materials. Lower Silesia's extensive transport infrastructure is a key factor enabling the effective integration of the regional mining sector with global supply chains of critical and construction raw materials.

2) Digital infrastructure

The Lower Silesian Voivodeship is one of the most important centers for the development and implementation of ICT solutions in Poland and Central Europe. Wrocław, the regional capital, is, alongside Warsaw and Kraków, the country's most important startup and BPO (Business Process Outsourcing) hub. This dynamic development would not be possible without ensuring appropriate digital infrastructure throughout the voivodeship. In 2015, the construction of the Lower Silesian Broadband Network (DSS) was completed. The network spans all counties and 139 municipalities in the Lower Silesian Voivodeship. The network's structure enables it to extend its reach to all municipalities in the voivodeship. The DSS enables all interested telecommunications companies to provide broadband services directly to end users—residents, businesses, and institutions—in Lower Silesia. In Lower Silesia, the percentage of businesses with broadband internet access in 2022 was 98.4%, compared to the national average of 98.5%.

3) Water

Access to water is crucial for mining and smelting operations, including the critical raw material copper. At the same time, water is a valuable resource, so it is crucial to use it thoughtfully and with a circular economy's priorities in mind.

The most water-intensive mining operation in Lower Silesia is copper mining, conducted by KGHM Polska Miedź PLC, which adheres to the highest standards, striving to utilize this valuable resource most efficiently. The flotation process uses exclusively mine water extracted from the rock mass, ensuring that freshwater resources—both underground and surface—are not used in production. Water is also used in smelting processes: KGHM Polska Miedź PLC's smelters draw water from the Odra and Kaczawa rivers, and the water is then directed to an industrial wastewater treatment plant operated by a subsidiary of the company. In 2025, the company withdrew nearly 84 million m³ in total (10.7 million m³ surface water, 24.65 million m³ groundwater, over 48 million m³ mine water), recycled and reused over 144 million m³, and discharged over 61.5 million m³ back to surface water bodies (US Wrocław, 2025a).

Beyond industrial use, the voivodeship's broader water balance is shaped by three distinct demand streams. The water-supply network for households and services accounts for 136.7 hm³ (37.3% of the region's total consumption of 366.4 hm³), reflecting the region's high urbanisation rate. Fishpond filling and topping-up — concentrated in the Barycz Valley (Milicki and Trzebnicki counties) — accounts for 123.6 hm³ (33.7%), making Lower Silesia the national leader in this category. Industrial abstraction from own intakes represents the remaining 106.1 hm³ (29.0%). Total water abstraction for the regional economy and population stands at 378.8 hm³ (4.5% of national abstraction of 8,459.4 hm³), while per-capita consumption of 127.4 m³/person places the voivodeship seventh among Poland's sixteen

regions. The communal infrastructure is well-developed: the water-supply network spans 21,200 km, serving 95.4% of the regional population, while 78.0% of inhabitants — above the national average of 76.2% — are connected to the 13,500 km sewerage network. In 2024, 95.7% of the 219.6 hm³ of wastewater generated was treated across 221 municipal treatment plants. Regional investment in water management reached PLN 512.7 million — the highest per-capita expenditure (PLN 741/person) of any Polish voivodeship (US Wrocław, 2025a; US Wrocław, 2025b). These priorities are addressed by the Lower Silesian Water Policy (Dolnośląska Polityka Wodna, DPW), which embeds a “water priority” across all sectoral policies in line with the EU Water Framework Directive and the CRMA resource-security objectives (Instytut Rozwoju Terytorialnego [IRT], 2024).

Lower Silesia also holds an exceptional position in Poland for its mineral and thermal waters. The voivodeship hosts 20 of Poland’s 109 formally designated healing-water deposits, with aggregate exploitation resources of approximately 615 m³/h — equivalent to 32% of the national total (Sokołowski & Sosnowska, 2022). Three principal water types occur: CO₂-rich bicarbonate waters (szczawy), therapeutic radon waters (found nowhere else in Poland), and thermal waters reaching up to 87.8°C at Jelenia Góra-Cieplice. These resources sustain eleven statutory spa towns — including Duszniki-Zdrój, Polanica-Zdrój, Kudowa-Zdrój, Łądek-Zdrój and Świeradów-Zdrój — supporting balneotherapy, mineral water bottling, natural CO₂ production and cosmetics manufacturing. Interest in geothermal energy is growing, with approximately ten new thermal-water projects under development as recommended by the DPW framework and the regional energy strategy. Rational management — including updated hydrogeological documentation and protection of recharge zones — is a key regional priority (Sokołowski & Sosnowska, 2022; IRT, 2024).

4) Energy

The Lower Silesian Voivodeship Board has developed and adopted in October 2022 the "Lower Silesia Energy Strategy – Directions of Support for the Energy Sector," which defines regional goals and directions of actions supporting the energy transition. Currently, the Lower Silesian Voivodeship does not stand out among other regions in terms of energy production from renewable energy sources, but it is characterized by a high level of electricity production from conventional sources. It should be noted that the level of electricity production in recent years has remained close to the average in other voivodeships. The primary source of electricity supply for customers in the Lower Silesian Voivodeship is the national power system, whose components (400 kV and 220 kV substations and lines) enable the output of power from the Turów Power Plant, which uses lignite supplied by the Turów Lignite Mine and the Opole Power Plant, as well as the interconnection of the national system with the international (German) system.

7. People, Skills & Social Licence to Operate (SLO)

1) Workforce and skills

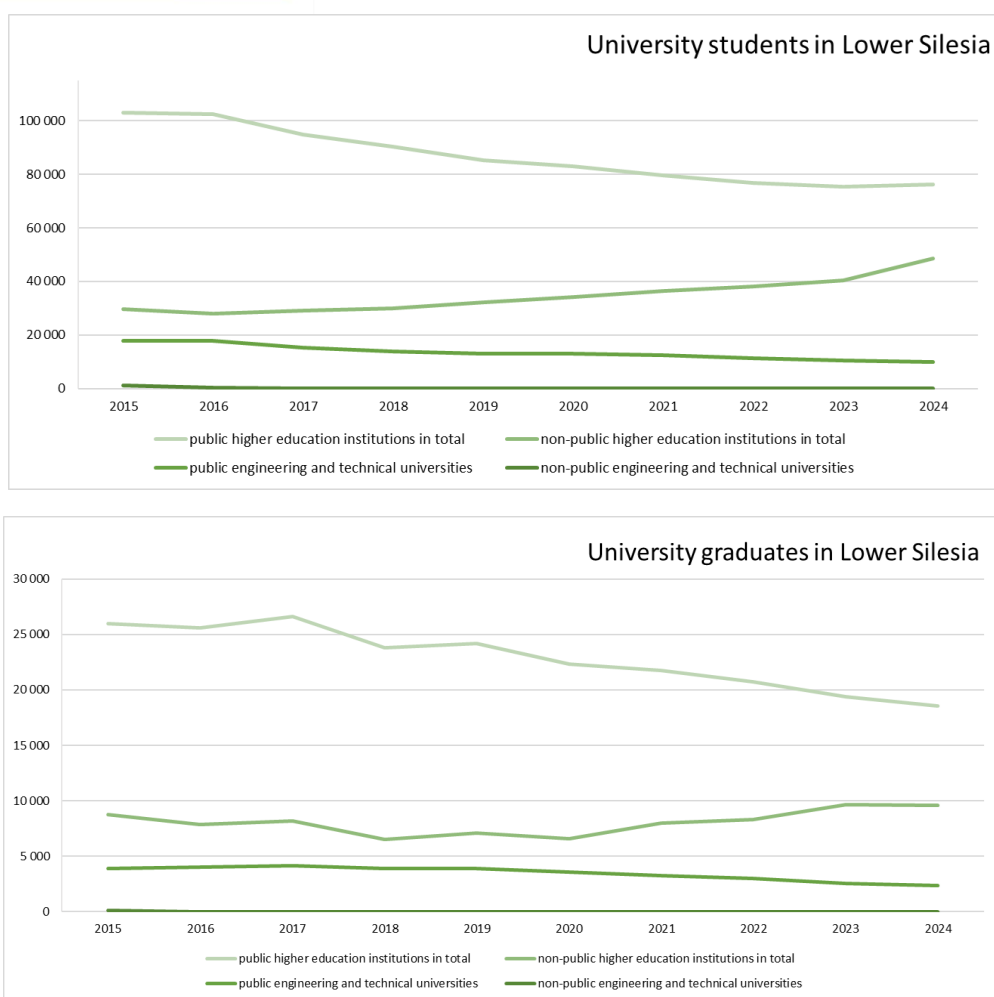
In Lower Silesia, the mining and extraction sector employed 19,826 people in 2025 (Statistics Poland 2026). The largest employer in the region is KGHM Polska Miedź PLC, employing approximately 18,000 people. Job positions at KGHM Polska Miedź PLC can be divided into several main categories, depending on the location and nature of the duties performed. These include mining sector employees working underground and responsible for copper ore extraction, such as mine supervisors (foremen,

chief foremen, mining engineers), heavy face machinery operators, geologists, mine surveyors, and underground maintenance workers (electricians, locksmiths, mechanics, and electromechanics). After extraction, the ore is delivered to the processing and metallurgical sector, which employs mineral processing specialists (mineral flotation tankers, mineral reagent tankers, process and processing engineers, processing equipment operators, dispatchers, automation specialists, and maintenance workers) and metallurgy specialists (metallurgical engineers and technologists, process operators, automation specialists, and electricians). Another sector comprises administrative, financial, and HR staff, including financiers, accountants, business analysts, occupational health and safety and environmental protection specialists, lawyers, international trade experts, and supply logistics experts. Modern mining companies are also digitally advanced, employing specialists in data analysis, cybersecurity, and programming, among others.

The remaining mining sector workers are employed in small- and medium-sized mining enterprises that exploit rock raw materials. These typically include small gravel and sand pits (3 to 10 employees), medium-sized quarries producing road aggregates (15 to 40 employees), and large rock mining enterprises (50 to 150 employees). Lower Silesia has approximately 268 active mines and mining plants extracting rock raw materials (UMWD 2026). The employment structure in rock raw material mines differs significantly from that of KGHM Polska Miedź PLC. The entire process takes place on the surface and is largely mechanized. These enterprises employ significantly fewer people performing simple manual labor, with operators of heavy construction and mining equipment and automation specialists playing key roles. In a medium-sized mining enterprise, the workforce is divided into: a production department responsible for extraction and processing, approximately 60-70% of the workforce (machine operators, haul truck drivers, quality control workers); a technical and maintenance department, approximately 15-20% of the workforce (machine mechanics, welders, electricians, automation specialists, blasting crews); an engineering and technical supervision department, approximately 5-10% of the workforce (mining plant operations managers, foremen, surveyors, geologists); and an administration and logistics department, approximately 10% of the workforce (salespeople, logisticians, finance specialists, occupational health and safety and environmental protection specialists). Many rock mines reduce their permanent staff to a minimum by hiring external companies, for example, for blasting or transporting raw materials to customers.

2) Education and training

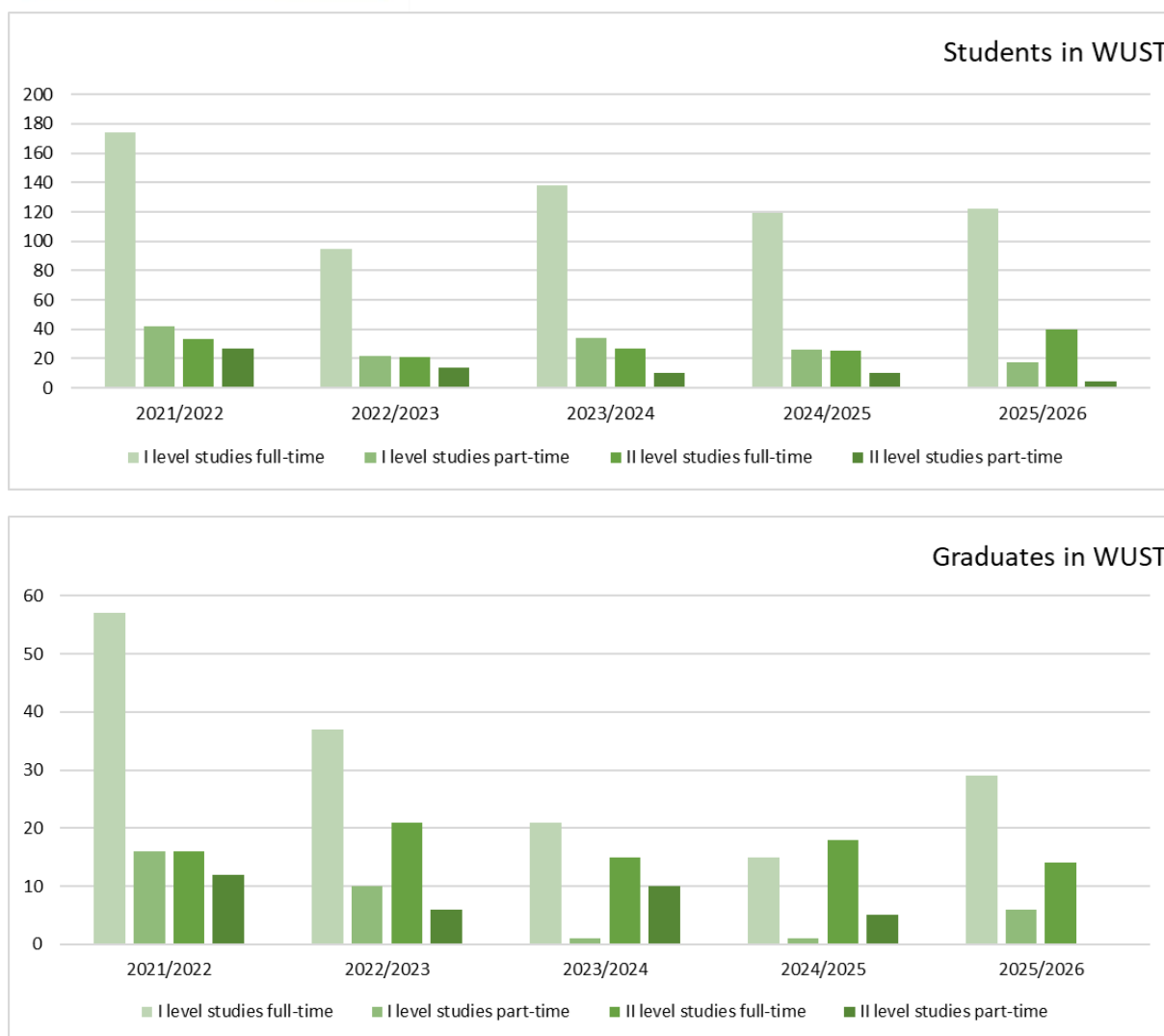
The most important institutions for training personnel within the Lower Silesian mining ecosystem are characterized in Table 3.1.4, which presents the largest public universities and several private entities. Data on graduates and students of higher education institutions at public and private universities offering engineering and technical programs were obtained from the Central Statistical Office (Statistics Poland 2026). A decline in the number of students in engineering and technical programs at public universities was observed.



Pict. 7.2.1. Number of students and graduates at universities in Lower Silesia

Source: Statistics Poland 2026

In the years 2021-2026, the Wrocław University of Science and Technology offered full-time and part-time first- and second-cycle studies at the Faculty of Geoengineering, Mining, and Geology in the following specializations: mining and geology, mineral resources engineering, geoenergy, geoinformatics and applied geology. Figure 7.1.2 shows the number of students and graduates studying mining-related subjects.



**Pict. 7.2.2. Number of students and graduates
at Wrocław University of Science and Technology
(As at December 2025)**

3) Social Licence to Operate (SLO) and Corporate Social Responsibility (CSR)

Lower Silesia is a region with an exceptionally strong mining tradition and one of the most important mineral extraction areas in Poland. The concentration of strategic copper and silver ore deposits, numerous mining plants exploiting rock minerals (often unique in the country), and a rich mining heritage make the issue of social acceptance of mining operations particularly important for the further development of the region and the broader raw materials industry. Furthermore, the region is characterized by a significant concentration of areas of valuable natural resources, attractive for tourism, and housing, making the issue of building a social license to operate an increasingly important element of raw materials policy, including at the regional level.

In Poland, the SLO concept is currently not formally incorporated into the legal system or administrative procedures related to geological and mining activities. Public acceptance for projects involving the exploration and exploitation of mineral deposits can be built primarily through legally required public consultations conducted as part of planning and environmental procedures. Selected procedures from these two categories are a mandatory element of obtaining an exploration,

exploration, and/or mining license. Their scope, of course, depends on the scale of the planned mining project. In practice, these activities are often undertaken at the investment preparation stage, when local communities first receive information about the planned activity. This means that social dialogue is often reactive and focuses on potential spatial, environmental, or social conflicts. Obtaining formal permits and licenses therefore concludes the earlier process of preparing the legally required documentation and project designs. Examples of such processes in open-pit mining in Poland (including the Lower Silesian Voivodeship), resulting from the introduction of environmental impact assessment procedures (also taking into account the specific nature of Natura 2000 sites), present a hierarchical set of activities and procedures leading to the issuance of an administrative decision by the licensing authority. As a result of the consultation process and the preparation of the required documentation, two possible outcomes arise: a permit is refused or an administrative decision is issued. Granting a social permit to operate is a continuous process, in which it can be obtained and lost at any stage of the mining project's lifecycle. Unfortunately, examples of both can be found in the Lower Silesian Voivodeship. In practice, the greatest challenges related to SLOs in the region do not concern underground copper ore mining, which has been operating for decades and is deeply rooted in society, but primarily open-pit operations related to the exploitation of rock minerals.

In Lower Silesia, the level of social acceptance for mining activities varies depending on the type of minerals being mined and local historical and environmental conditions. In the Legnica-Głogów Copper District, mining activities have been conducted continuously for decades and constitute one of the foundations of the region's socio-economic development. The operation of mining and processing plants is strongly linked to the local labor market, education system, and infrastructure development, which translates into a relatively high level of social acceptance for this activity. The situation is different in the case of open-pit mining. All rock minerals extracted in Lower Silesia, such as granite, basalt, melaphyre, gneisses, and natural aggregates, are extracted using open-pit methods, which involve direct and visible transformation of the landscape. Potential social conflicts primarily concern impacts related to the transportation of raw materials, noise and dust emissions, landscape changes, impacts on tourist attractions, and competition between mining, residential, and recreational functions. These phenomena are particularly visible in areas with developing tourism functions and adjacent to attractive landscapes. They are also most acute for entrepreneurs seeking to develop new mining operations.

The relatively low level of geological and raw material awareness among the public remains a significant challenge. The importance of minerals and the minerals derived from them, the country's resource security, the circular economy, and the role of the national resource base in energy transformation are covered to a limited extent in formal education. As a result, residents' knowledge of the mining sector is often fragmented, hindering substantive debate on new mining ventures and the future of regions associated with mineral extraction. However, the specific nature of Lower Silesia provides a good foundation for developing initiatives that support the development of social acceptance for the rational use of mineral resources. The region's rich geological and mining heritage, represented by numerous post-industrial facilities, museums, geoparks, and educational centers, plays a particularly important role. Examples of such initiatives include the "Stara Kopalnia" (Old Mine) Science, Culture, and Art Center in Wałbrzych, the Gold Mine in Złoty Stok, and the Land of Extinct Volcanoes Geopark, which utilizes former quarries and geological sites for educational and geotourism purposes. These institutions fulfill an important educational role, contributing to the dissemination of

knowledge about geology, mining, and the importance of mineral resources for the socio-economic development of the region. Furthermore, post-mining areas have been reclaimed and developed, and now serve a variety of social functions – educational, recreational, and tourist. The Colorful Lakelets (Wieściszowice) are one of the most famous examples. Formed in the excavations of former pyrite mining, they are now one of the region's most popular geotourist attractions and a key element of the local tourism economy. Former granite quarries, on the other hand, are an exceptionally interesting attraction in the Strzelin region. They are characterized by high natural values, particularly in terms of geodiversity, tectonic structures, and the region's mineralogical and petrographic richness. The reclaimed Wilcza Góra basalt quarry also offers exceptional educational value. Spectacular viewing points and platforms have been created here, located in various parts and levels of the quarry, from which one can observe an almost complete cross-section of the volcanic vent, with various types of volcanic rocks and older sandstones, as well as the effects of other volcanic phenomena.

The transformation of former mining regions is also a significant element of the regional social context. The examples of Wałbrzych and Nowa Ruda demonstrate that the effects of the end of mining operations extend far beyond economic issues and also encompass social, cultural, and identity-related aspects. At the same time, the experiences of these areas indicate that mining heritage can be a significant development resource, utilized in tourism, education, and building local identity.

Activities undertaken by local governments, mining entrepreneurs, and research institutions also play a crucial role in building social acceptance. These include, among other things, geological and raw materials education, the promotion of industrial heritage, the organization of popular science events, and collaboration with schools and local communities.

The regional government has for years supported initiatives promoting knowledge about mining and extraction among the local population. Mining companies operating in the region also do this. A good example of such initiatives, implemented by the Lower Silesian Voivodeship over the years, is its participation in international projects that align with the CSR concept. The MineLife and REMIX projects are examples of such initiatives.

The **"Life with Mining (Acronym: Minelife)"** project was implemented by the Marshal's Office of the Lower Silesian Voivodeship in cooperation with the Saxon State Mining Authority in Freiberg and the State Mining Authority in Katowice. The primary goal of the project, implemented from April 1, 2017, to March 31, 2020, was to improve communication, intensify, and strengthen cooperation between mining institutions in Poland and Saxony, as well as between mining institutions and citizens in the Saxon-Lower Silesian border region.

The MineLife project partners rightly assumed that the exchange of knowledge and experience, mutual understanding, and the creation of a network of collaborations were essential to addressing existing problems. The first area of cooperation between the project partners was the joint development of competencies through knowledge exchange and intensified cooperation between institutions in the mining industry. Administrative procedures, planning processes, and the scope of supervision, as well as available technologies and procedures in open-pit and underground mining in the neighboring region, were analyzed. Conferences and study visits were organized to mines and former mining facilities in Saxony and Lower Silesia.

The second area of the project focused on conflicts typical of the industry and optimal ways to address them. A series of workshops in Poland and Saxony resulted in the development of a manual on conflict management and avoidance in mining.

The partners also jointly addressed the importance of mining in Saxony and Lower Silesia. In addition to substantive meetings, a traveling exhibition, "Preventing Risks Associated with Former Mining," was prepared, which was presented in several towns in the border area. The project also resulted in the creation of a guidebook, "In the Footsteps of Mining in Lower Silesia and Saxony," presenting numerous tourist attractions related to the mines in the border area, along with practical tips for visitors.

The REMIX project - Smart and green mining regions of the EU, was implemented in 2017 - 2021 under the Interreg Europe Program by: Marshal's Office of the Lower Silesian Voivodeship, Regional Council of Lapland (FI) - project leader, Institute of Business Competitiveness of Castile and Leon (ES), Business Development Agency Joensuu (FI), University of Mining in Leoben (AU), Faculty of Science and Technology, NOVA University in Lisbon (PT), Ministry of Industry and Trade (CZ), University of Exeter (GB), National Technical University NTUA in Athens (EL), Center for Geocompetence in Freiberg (DE) - Advisory partner.

The project aimed to develop cooperation aimed at improving regional strategic documents and exchanging experiences and best practices, including:

- 1) building synergies between regions, with clearly defined needs and responsibilities of each partner in order to achieve sustainable and efficient resource extraction in Europe;
- 2) improving the translation of industry needs into regional planning, policy, and decision-making, which should result in an improved environment for industry in the EU and supporting coherent regional development that provides favorable conditions for the growth of SMEs in the area of eco-innovation;
- 3) discovering and promoting potential regional synergies to create new development opportunities.

As part of the best practices, an activity was identified in Lower Silesia that implements the SLO priorities: **"Copper. The History of an Extraordinary Metal."** Exhibition at the Copper Museum in Legnica. The exhibition opened at the Copper Museum in Legnica and was created as part of the **"Virtual Mine - a Model Educational Tool about Mining / VirtualMine - as a Modeling Tool for Wider Society Learning"** project, funded by EIT Raw Materials. The project coordinator is KGHM Cuprum Ltd Research and Development Center.

The project aimed to create a modern educational program for children and young people to increase knowledge about raw materials and their role in the modern world, and to raise awareness of the importance of raw materials and their potential use for the better development of European regions.

In Lower Silesia, mining companies implement numerous corporate social responsibility (CSR) initiatives, including support for education, culture, sports, and social initiatives. These activities can foster positive relationships with stakeholders, but they should not be equated with the concept of Social License to Operate, although they can undoubtedly influence it. A social license to operate is a result of the level of trust and social acceptance, not a direct result of implementing specific social

programs. Its existence is determined primarily by the quality of social dialogue, the transparency of a company's operations, and the way it addresses the expectations and concerns of local communities. There is a connection between CSR and SLO, but not a cause-and-effect relationship. Many mining companies have for years treated CSR as a way to "buy social acceptance," a trend that is being abandoned by the contemporary approach to SLO. SLOs are built primarily through trust, participation, and dialogue, not through sponsoring local initiatives. This is particularly evident in conflicts surrounding new open-pit mines, where even socially active companies can encounter strong opposition from residents. Such examples are also evident in the Lower Silesian Voivodeship.

It is worth mentioning the initiatives undertaken by KGHM Polska Miedź PLC. The company has been involved in CSR activities for many years in areas as diverse as health, education, ecology, and supporting local social ties. The most important programs implemented by KGHM Miedź PLC include:

- 1) KGHM Academy - initiated in 2024. As part of this initiative, 44 preventive programs have already been implemented, benefiting 2,700 people, including students, their parents, caregivers, and teachers.
- 2) Mie (dź) Rodzinę i Rodzinne Strefy KGHM - This social campaign actively promoted and supported foster parenting in the region.
- 3) Mie (dź) apetyt na czytanie - an initiative supporting local libraries and reading.
- 4) "Copper Heart" employee volunteering program - implemented by KGHM Polska Miedź PLC employees. A number of projects, such as: KGHM na wesoło (KGHM for Fun), KGHM Dzieciom (KGHM for Children), and Śladami Jasia Wyżykowski (In the Footsteps of Jasia Wyżykowski). Support for sports initiatives is a permanent element of KGHM volunteers' activities.

Strzeblowskie Kopalnie Surowców Mineralnych Ltd has also been conducting its CSR activities for years, highlighting social responsibility and supporting the development of local communities as an important element of its corporate strategy. SKSM actively engages in educational, social, and cultural activities carried out in municipalities related to the company's mining operations.

The most important social initiatives include:

- 1) "Children's Day at SKSM" – an educational and integration event organized for second-grade primary school children from municipalities where mineral resources are extracted. This initiative is part of early mineral resource education for children and youth, aimed at raising awareness of the importance of the mining industry for the country's mineral security and the economic and social benefits for the region and its residents. The event introduces participants to the specifics of miners' work, safety regulations, and the role of domestic mineral resources in the modern economy;
- 2) "Barbórka Ślązańska" – a regional event integrating mining industry workers, local governments, and residents of the region, aimed at cultivating mining traditions and strengthening the cultural identity of the Śląza and Sobótka Massif region. The event also serves as an important element in building public awareness of the presence and importance of mining in the region and its historical and economic impact on the development of local communities.

8. Data Baseline & KPIs

Table 8.1. Lower Silesian Development Strategy 2030

Nr	Indicator name	Value of the indicator 2016	Expected value of the indicator 2030
1	Gross domestic product per capita [PLN]	52 203 PLN	75 000 PLN
2	R&D expenditures in relation to GDP and enterprises R&D expenditures in relation to GDP	0,85 0,49	2,00 1,80
3	Share of net revenues from sales of innovative products in industrial enterprises for export in total net revenues from sales [%]	11,05	16,00
4	Emission of gaseous pollutants from particularly harmful plants SO ₂ /NO ₂ [kg per capita]	6,9 3,8	4,8 2,9
5	Waste generated during the year (accumulated excluding municipal waste) [thousand tonnes]	35 579	32 600

Table 8.2. Lower Silesian Innovation Strategy 2030

Nr	Indicator name	Measurement frequency
1	Expenditures on innovation activities in industrial enterprises (by voivodeship)	annual
2	Industrial enterprises that incurred expenditure on innovation activities (by voivodeship)	annual
3	The value of subsidies awarded for the implementation of projects implemented in the area of economic transformation	annual
4	The value of subsidies awarded for the implementation of energy efficiency projects	annual
5	The value of subsidies awarded for the implementation of projects implemented for environmental transformation	annual

6	Number of supported installations in the field of reducing the amount of waste generated in production processes	annual
7	The amount of reduced waste remaining in the company's production process	annual

9. Preliminary SWOT

SWOT ANALYSIS LOWER SILESIA REGION (POLAND)

Resource and Mining Waste management

STRENGTHS

	Average Score (1-5)	Top Score (%)
Regional mining experience and traditions	4,61	94
Mining companies and industrial sector – presence of large stable companies	4,48	91
Raw material base and geological resources – very high diversity of mineral deposits	4,48	85
Strong scientific and research base – numerous experts in the extractive sector	4,48	85
Resource potential in waste Possibility of future recovery of additional raw materials from waste.	4,07	76
R&D, innovation and science–industry cooperation	3,79	69

WEAKNESSES

	Average Score (1-5)	Top Score (%)
Social opposition and concerns regarding mining impacts	4,59	88
Spatial and environmental constraints limiting new deposits	4,44	85
Legal, administrative and regulatory barriers – complex permitting procedures	4,35	79
Difficult access and development of new deposits	4,12	73
Complex and lengthy administrative procedures	4,81	95
Dominance of traditional waste landfilling	4,71	95
Difficulties in locating new processing installations and landfills.	4,67	95

OPPORTUNITIES

	Average Score (1-5)	Top Score (%)
High regional resource potential including unique deposits	4,52	88
Growing EU demand for critical and strategic raw materials	4,61	85
Strong human capital and professional experience	4,24	79
Strengthening cooperation between science and mining industry	4,12	76
Opportunity for more in-depth exploration and fuller utilization of waste resources.	4,23	85
Strong scientific base supporting the development of innovation and cooperation with industry.	4,19	85
Possibility of using mining waste in construction, road engineering, and land reclamation.	4,27	81

THREATS

	Average Score (1-5)	Top Score (%)
Stricter environmental and climate regulations increasing costs	4,6	93
Lack of systemic deposit protection	4,5	87
Strong social opposition to new investments	4,3	83
High energy costs and limited R&D funding	4,3	83
Tightening environmental regulations increasing the costs of landfilling, processing, and land reclamation.	4,52	89
High investment and operating costs of processing facilities, hindering modernization of the sector.	4,41	85
Public opposition and low awareness regarding waste management and mining-related projects.	4,33	85

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