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Identification of Market Gap as a Chance for Enterprise Development—Example of Polish Raw Materials Industry

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Abstract: The raw materials sector plays a key role in the Polish economy. The mineral raw material industry encompasses many different, sometimes highly specialized activities, such as exploration, mining, hauling, mineral processing, metallurgy and metal refining, as well as risk assessment, management (environmental, financial, legal) and marketing. The purpose of the article is to identify the market gap for business for entities or individuals in the mineral resources sector in Poland. Taking into account the European Union regulations which enforce the closure of hard coal mines in Poland by 2050, it is reasonable to identify such a gap in the raw materials area, especially since the current situation may turn out to be a new revival of the raw materials market after the pandemic period. Based on the NACE classification, a key area was identified, which is dedicated to potential entrepreneurs in the mineral resources area. Based on an internal analysis, the sectors directly related to the RM field in Poland were distinguished. Narrowing down the analyzed sections, leading areas were indicated that offer significant employment opportunities for hundreds of thousands of people who will be made redundant (often in groups) as a result of the phasing out of hard coal mining in Poland. As part of the article, the identification and analysis of key trends that have a significant impact on the functioning of companies, the industry, the region or the country, as well as threats, challenges and opportunities that may arise in the near future, was carried out. What is more, a number of scientific, research or development projects implemented in the area of mineral raw materials in the years 2010–2019 were analyzed. The authors present an innovative approach to defining the gap in the mineral raw materials sector in Poland in what regards conducting business activity, as well as an in-depth analysis of the sector in terms of enterprise development opportunities (creation of new start-up companies) and its directions. It should be mentioned that the presented research is the first attempt to analyze this issue in Poland.

Keywords: raw materials sector; gap in the mineral raw materials industry; enterprise development

Citation: Sukiennik, M.; Kowal, B.; Bąk, P. Identification of Market Gap as a Chance for Enterprise Development—Example of Polish Raw Materials Industry. *Energies* **2021**, *14*, 4678. https://doi.org/10.3390/en14154678

Academic Editor: Patrycja Hąbek

Received: 10 June 2021
Accepted: 29 July 2021
Published: 1 August 2021

1. Introduction

The raw material sector is currently experiencing many difficulties [1]. Uncertain economic, social, environmental and political conditions, the sector's transition from a traditional to a low-carbon economy and the structural changes taking place in the energy industry have resulted in a raw material market crisis. These economic downturns, which cause the unstable functioning of enterprises, inhibit their development and the possibility of overcoming the risk of insolvency, especially when crises are caused by objective circumstances beyond human control [2]. The pandemic, which has prevailed for more than a year, not only in Poland, is such a circumstance, a factor with a deteriorating effect on the industry. COVID-19 dealt a devastating blow to the global economy, as it disrupted supply chains and reduced demand, which also translated into a significant drop in electricity demand in many areas [3]. In the Polish raw materials industry, it was necessary to make a number of changes to ensure the safety of workers and change the guidelines so that all activities comply with the restrictions and regulations in force because of COVID19 [4].

The situation of the raw materials market in Poland is difficult. In 2019, the European Commission published a communication on the European Green Deal—A strategy to achieve climate neutrality in the European Union (EU) by 2050 [5–10]. In the same year, we witnessed the completion of the Clean Energy for All Europeans package, which outlined how the EU's 2030 climate and energy targets would be implemented.

In connection with the adaptation of the activities of raw material companies of the extractive sector to the binding regulations of the European Union and the current market requirements, they began to face increasing challenges, among which the following should be mentioned: environmental protection requirements and reduction of greenhouse gas emissions, as well as social and economic challenges [11–23]. The legal, political and environmental conditions presented in the documents indicate that, without innovation, the functioning of the industry will be threatened. This necessity is dictated by the need to ensure the competitiveness of the sector, independence and the competitiveness of the national economy [24].

At this difficult time, coal mining is particularly at risk. Last autumn, in September, the media announced that a preliminary agreement was signed between the government and miners concerning the closure of mines in Poland. The draft of this social contract stemmed from the latest strategy contained in the "Energy Policy of Poland until 2040," which assumes that by 2030 the share of coal in the Polish energy mix is to decrease by more than half, i.e., to 37%, and by 2040 it is expected to be as low as 11%. These indicators have become global measures of PEP2040 target achievement [25,26] and have put Poland's energy policy at a crossroads.

The decarbonization scenario is associated with a less stable energy production, a dependence on imported technologies and, most importantly, the loss of mining jobs [27]. The magnitude of the changes in the Polish mining sector is evidenced by the fact that the closure concerns 13 thermal coal mines, which employ approx. 56.5 thousand people and operate in 43 municipalities [28]. The planned decarbonization of the Polish economy means reducing both employment and production in fuel coal mining [29]. Although an agreement on the transformation of the mining industry has been signed, in which the underground miners are guaranteed work in the mines until retirement (a significant part of the mining workforce will retire in the coming years), the rest and the newly employed must be given a professional perspective. They will require relocation to other mines or requalification (retraining support), so it is important to monitor market and resource industry developments and positions or competencies (transitions between positions within plants).

In addition, problems related to the lack of stability and job security are compounded by the already mentioned current global situation—The occurrence of epidemic threats [30]. All this results in a lack of a sense of safety among mineworkers and their families, and yet the miners' awareness of safety at work has a huge impact on the way they perform their jobs [31–33].

The Coronavirus swayed commodity and raw material prices last year. Successive waves of the pandemic crippled the global economy, causing the demand for many commodities to plummet [34]. However, recent months have seen an increase in raw material prices. This may indicate that raw materials are beginning to recover from a decade-long slump. According to a Goldman Sachs analysis, "raw materials have plenty of reason to get more expensive this year. This may just be the beginning of a great bull market. The gains will be driven by inflation, dollar depreciation and a recovering global economy after the pandemic." [35]. At the moment, it is difficult to talk about market stability due to the unpredictability associated with the pandemic.

The mineral raw material industry encompasses many different, sometimes highly specialized activities, such as exploration, mining, hauling, mineral processing, metallurgy and metal refining, as well as risk assessment, management (environmental, financial, legal) and marketing. Given the consumer demand for quantity, quality and speed in the supply of minerals, metals and energy in the raw materials market, there is a need to renew the

industry and improve its efficiency [36]. The natural resource extraction industry is very complex. It can be developed by taking innovative measures to improve the efficiency of the mining and processing of minerals, as well as improving conditions for fledgling companies. The current situation in the raw materials market should be seen as the beginning of a new animation of the raw materials market. Certainly, the need for its funding will lay the groundwork for the creation and growth of new start-up companies. The activity of start-ups in specialized, essential areas will allow the raw materials market to continue to function and may contribute to a faster and more efficient recovery. Moreover, a continuous innovation will ensure the country's energy independence and the competitiveness of the national economy, as well as the miners' job security and environmental protection.

The presented literature review shows that the raw materials industry is widely presented in terms of the most frequent changes and environmental trends or legal conditions that determine its functioning and limit activities, e.g., in the case of hard coal mining. To this day, a research similar to the one presented in this article has not been undertaken or described in the available publications, and therefore this issue becomes vital, especially concerning Poland.

In view of the above, the work aims to identify the market gap for conducting business activity for entities or individuals in the mineral raw materials sector in Poland, which may contribute to the revival of the raw materials market after the crisis caused by the pandemic and the European Union regulations which enforce the closure of hard coal mines in Poland by 2050.

The authors of the publication posed the following research questions: What is the current situation of the mineral raw materials industry in Poland? What are the environmental and legal conditions? What directions are currently and in recent years the subject of research of scientists in the area of mineral raw materials? In which area of the raw materials market is there room for new entities, new investors?

The authors based their answers on the analysis of available data. The research included several stages, e.g.,:

- Analysis of the mineral raw materials market in Poland.
- Analysis of business activity profiles according to the Statistical Classification of Economic Activities in the European Community (NACE) aimed at the identification of areas in which activities are related to the mineral resources market in Poland.
- Analysis of data from RM projects carried out in Poland (based on four databases).
- Analysis of keywords in selected projects aimed at the identification of the most popular ones.
- Aggregation of relevant keywords for individual areas of activity according to NACE.
- Determination of current trends (concerning a sector gap) in the raw materials industry in Poland.

2. Mineral Raw Materials in Poland

The Polish policy framework for raw materials, more specifically for geology and mining, is governed by the Polish Geological and Mining Law (GML) adopted on 9 June 2011. It deals with issues such as geological work, extraction of minerals from deposits, storage of substances, waste and carbon dioxide below the surface.

Poland is a country with relatively large and diversified mineral resources. Four groups are distinguished according to their use: energy resources (fuels), metallic resources (metal ores), chemical resources and rock resources (construction). The composition of the main mineral resource groups is presented in Figure 1.

In Poland, the resource base is diversified and includes many different mineral resources, distributed practically across the whole country (Figure 2). It plays a decisive role in the gap of mining, but it also affects the development of other branches of industry which use mineral resources, and as a result, the functioning of the entire Polish economy. Mineral resources provide the state with a high level of technological development and ensure that the demand for energy, building materials and other products, which are the basis of

industry, is met. In the face of diminishing resources and increasing energy demand, it is important to develop the sustainable use of mineral resources as enshrined in the country's energy policy. One of the most important tasks for the mining industry in Poland is to develop innovative methods of utilizing raw materials, taking into account the maximum possible reduction of the adverse impact of exploitation on the natural environment. Increasingly difficult geological conditions associated with mineral extraction require the introduction of modern technologies. The rational management of resources, the development of new technologies and a guaranteed energy security can be achieved through the interaction of the scientific, economic and political spheres. The directions of Poland's energy policy, which must be implemented in the long term, consistently and in correlation with the European Union requirements, are created through this cooperation [37].

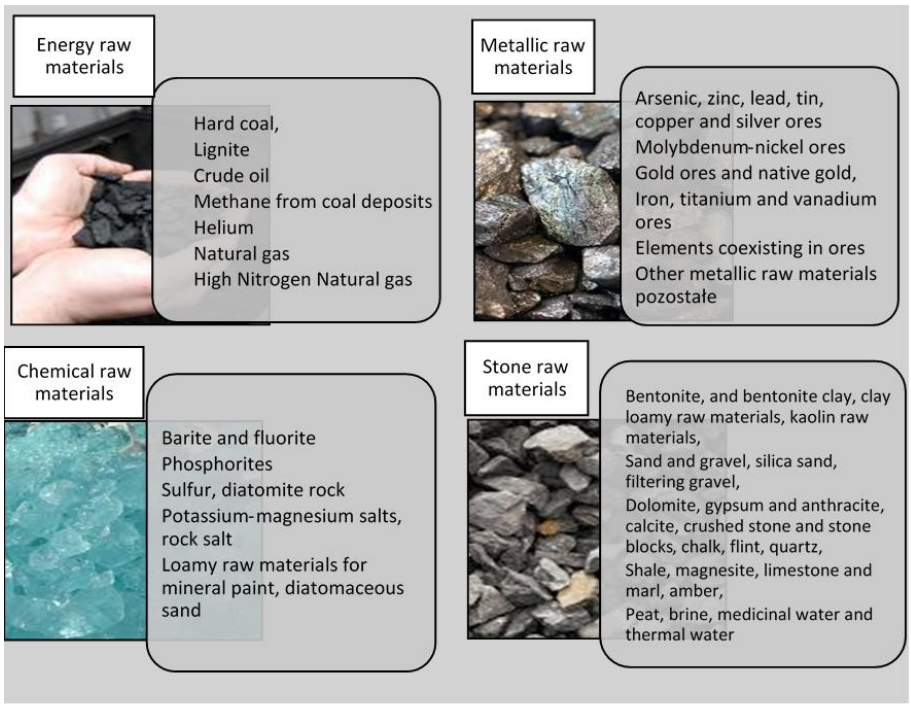

Figure 1. Groups of mineral raw materials in Poland (own study).

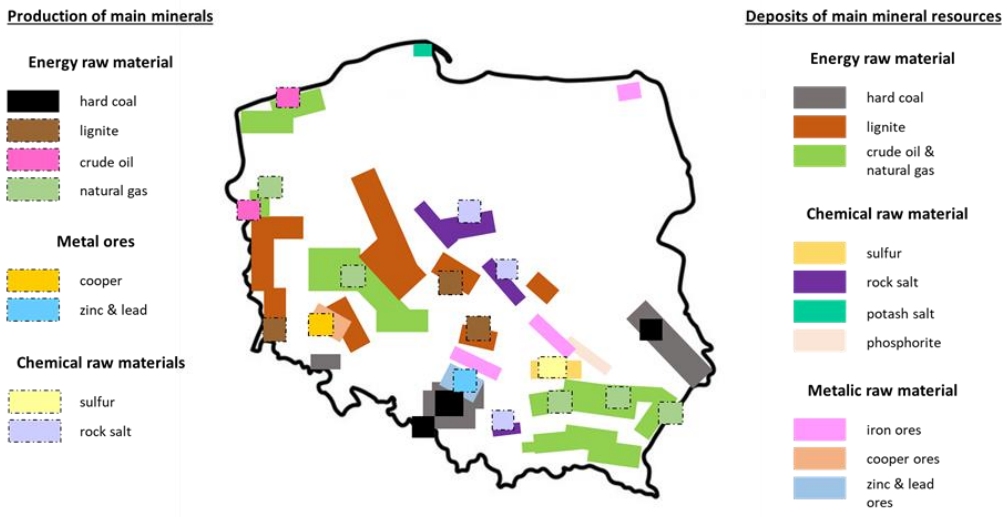

Figure 2. Distribution of main groups of mineral raw materials in Poland. Own elaboration based on [38].

In Poland, there are: hard coal, lignite, rock salt, copper, zinc and lead ores. Energy raw materials play a key role in the Polish economy.

The basic raw material for energy in Poland is hard coal. Its deposits occur naturally in three basins: Upper Silesian Coal Basin, Lublin Coal Basin and Lower Silesian Coal Basin. Currently, coal is mined in two basins—The Upper Silesian Basin and the Lublin Basin. The Upper Silesian Coal Basin is the main basin of Poland, as it contains over 80% of documented Polish hard coal reserves. The share of hard coal in the total energy consumption in Poland in 2019 was 37%, lignite—9.1%, oil—26.3%, natural gas—16.1%, renewable energy carriers—9.3% and other carriers—2.2% [39].

In Poland, the most common lignite is found in younger geological periods, mainly in the Paleogene and Neogene. Lignite deposits of the Jurassic, Carboniferous and, rarely, Cretaceous and Triassic ages are also known worldwide. In terms of carbonization, this coal is an intermediate composition between hard coal and peat. The type of plant matter from which lignite was formed and the conditions of its formation greatly affect its characteristics and properties. Lignite deposits were formed on platform lids and in collapsed orogenic areas. Lignite forms deposits that are several dozen meters thick or occur in the form of lenses. The generally small thickness of the overburden makes it possible to mine this coal using open-pit methods. Underground methods are most often used to exploit deposits of older geological formations and deposits occurring in glaciotectonic folds. Geological balance resources in developed deposits were 1170.81 million t as of the end of 2019 and accounted for 5.03% of total geological balances. Lignite from these deposits is exploited in five mines: Bełchatów, Turów, Adamów, Konin and Sieniawa.

Documented oil deposits in the Polish Lowlands occur in Permian, Carboniferous and Cambrian formations. It is a medium paraffinic oil containing 4.3–7.4% paraffin, just over 1% sulfur and with a density of 0.857–0.870 g/cm^3. These reservoirs mostly belong to massive deposits, with passive bedding water and gas-expansive production conditions. The largest deposit is BMB (short for Barnówko-Mostno-Buszewo), near Gorzów Wielkopolski. Initially, its resources were more than twice the size of Poland's oil resources before its discovery. There are also other significant oil deposits in the Polish Lowlands: Lubiatów, Grotów and Cychry. In the Carpathians, oil deposits occur in several tectonic units, but most are in the Silesian unit. These are mainly structural, and less frequently structural-lithologic deposits, primarily of the stratified type with the surrounding water. Production is achieved initially by the expansion of dissolved gas in the oil, and later by gravity. In Poland, 87 crude oil deposits were documented in 2019, including 29 in the Carpathian Mountains, 12 in the Carpathian Foreland, 44 in the Polish Lowlands and 2 in the Polish Baltic Economic Zone. The deposits found in the Carpathian Mountains and its foothills have a long history; this is the region of the world's oldest oil mining. Currently, the resources of these deposits have nearly run out. In Poland, the greatest economic importance is attributed to oil deposits in the Polish Lowlands. In 2019, the recoverable resources of the deposits in the Lowlands represented 65.7%, and the resources of the deposits in the Polish economic zone of the Baltic Sea 27.7% of the national resources. The resources of the Carpathian Foreland and the Carpathian Mountains play a subordinate role (3.6% and 3.0% of national resources, respectively).

In Poland, copper and silver ore deposits occur in Lower Silesia, in the Fore-Sudetic Monocline and the North-Sudetic Trough. These are sediment-hosted stratiform copper deposits-SSC, Kupferschiefer-type. Copper mineral clasts, admixed with other metals, occur in the Zechstein copper-bearing shale, in the underlying sandstones and in the overlying dolomites and limestones. The main deposits, of great economic importance, are located in the vicinity of Lubin, on the Fore-Sudetic Monocline. In 2019, two new deposits were documented on the Fore-Sudetic Monocline in the Lubuskie Voivodeship: Nowa Sól and Żary. In 2019, KGHM Polska Miedź S.A. produced 565.6 thousand t of electrolytic copper, including 418.3 thousand t from own concentrates and 147.3 thousand t from foreign concentrates. In addition, 3225 kg of gold was produced from both own and foreign concentrates.

As far as chemical raw materials are concerned, sulfur, occurring in the northern part of the Carpathian Foredeep and rock salt, located in the central part of our country (Kłodawa, Mogilno, Góra), are particularly noteworthy. For several years, the global economy has seen a dramatic decline in native sulfur production. Fossil native sulfur is expensive to extract, which is why it is being replaced by cheaply sourced sulfur recovered from sulfided natural gas and oil deposits. Four deposits of sulfided oil and gas have been documented in Poland. It is recovered from the BMB (Barnówko-Mostno-Buszewo), Cychry and Zielin deposits and periodically from the Górzyca deposit. Rock salts occur in Poland in two main salt-bearing formations: Miocene and Zechstein. Salt deposits of Miocene formation, located in the Fore-Carpathian depression, mainly near the edge of the Carpathian overthrust from Silesia through Wieliczka and Bochnia toward the eastern border of Poland, were recognized and developed the earliest. Their exploitation was terminated in 1996 when the Wieliczka mine ceased production. Documented balance resources (without protective pillars) of Miocene salt deposits amount to over 4.36 billion tons, which is currently approx. 4.8% of the national balance resources of this raw material. The complex geological structure of these deposits (dominated by fold and fold-and-deck deposits, with only the Rybnik-Żary-Orzesze deposit being a seam deposit in a tectonic trench), the variable quality of salt, as well as the water and gas hazards mean that it is now hardly profitable to extract salt from them, and the historical mines (Wieliczka, Bochnia) function as museums and tourist-recreational facilities [40].

In Poland, there are also deposits of rock materials used in a wide range of building and road construction operations, e.g., granite and dolomite.

3. Materials and Methods

3.1. Raw Material Sector Definition According to NACE Classification

The Statistical Classification of Economic Activities in the European Community (NACE for short) sets out the nomenclature of economic activities in the European Union (EU). Various versions of NACE have been developed since 1970. The term NACE comes from the French Nomenclature statistique des activités économiques dans la Communauté européenne. NACE is a four-digit classification that provides a framework for the collection and presentation of a wide range of statistics according to economic activities in the field of economic statistics (e.g., production, employment and national accounts) and other statistical domains developed within the European Statistical System (ESS) [41].

The identification of the key area that is dedicated to potential entrepreneurs in the area of mineral resources in Poland was made on the basis of the NACE classification. In Poland, a faithful equivalent of this classification is PKD (Polish Classification of Activities), which is integrated into the European NACE. Based on an internal analysis, the sectors directly related to the RM field in Poland were distinguished.

All businesses operating in Poland conduct their activities within the Polish Classification of Activities. It is consistent with the international classification of NACE. In order to isolate the market gap, an analysis of those PKD areas where entities could operate in the mineral drawing area in Poland was conducted first.

The mineral raw materials area includes several sections of this classification. These are primarily:

- Section B—MINING AND EXTRACTION
- Section C—INDUSTRIAL PROCESSING
- Dept. 35—ELECTRICITY, GAS, STEAM, HOT WATER AND AIR CONDITIONING SUPPLY
- Section E—WATER SUPPLY, SEWERAGE, WASTE MANAGEMENT AND RECLAMATION ACTIVITIES
- Section F—CONSTRUCTION

It also encompasses sections that are not directly related to the industry at first glance, but are widely occurring in it:

- Section J—INFORMATION AND COMMUNICATION

- Section M—PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES
- Section N—ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES
- Section P—EDUCATION

Analyzing these sections and the areas where the gap may be identified in greater detail, the selected areas in the sections mentioned above were extracted for further analysis. In particular, these areas are:

- Mining of hard coal, lignite, ornamental and building stone, limestone, gypsum, chalk and slate, gravel and sand, clay and kaolin, salt, etc.
- Mining of crude oil, natural gas, iron ore, uranium and thorium ores, other non-ferrous metal ores, etc.
- Support activities for petroleum and natural gas extraction and other mining and extraction
- Manufacture and processing of coke and refined petroleum products
- Manufacture of technical gases, dyes and pigments, basic inorganic and organic chemicals, fertilizers and nitrogen compounds, explosives, chemical fibers, basic pharmaceutical products, plastic packaging, flat glass, ceramic tiles, insulators made of lime and plaster, concrete construction products, plaster products, pig iron, ferro-alloys, cast iron and steel and metallurgical products, tubes, pipes, hollow sections and fittings of steel, production of precious metals—lead, zinc, and tin copper—and other non-ferrous metals
- Manufacture of nuclear fuel
- Casting of iron, steel, light metals, copper and copper alloys, other non-ferrous metals
- Manufacture, transmission, distribution and trading of electricity
- Manufacture, distribution and trade in gaseous fuels
- Steam, hot water and air manufacture and supply
- Water and sewage collection, treatment and supply
- Collection, treatment and disposal of hazardous and non-hazardous waste
- Treatment and neutralization of hazardous waste
- Recovery of sorted materials
- Reclamation and waste management
- Building works related to the erection of residential and non-residential buildings
- Construction of roads and highways, construction of railways and underground railroads, construction of bridges and tunnels, transmission pipelines and distribution networks, waterworks
- Demolition
- Preparation of the site for the construction
- Excavation and geological and engineering drilling, electrical installations, plumbing, heating, gas and air conditioning installations.

According to the statistical data [41], the leading industries in the area of mineral raw materials in Poland are:

- Hard coal mining (4th place in the world),
- Silver extraction (6th place in the world),
- Hard coal mining:
    - Coking (8th place in the world),
    - Energy sector (10th place in the world),
- Copper mining (13th place in the world),
- Salt extraction (15th place in the world).

According to the rankings, the Polish industry is ranked lower in the mining of lead (16th in the world), kaolin (19th in the world), gypsum and anhydrite (21st in the world), sulfur (22nd in the world), zinc (26th in the world). We rank last in natural gas (50th in the world) and crude oil production (65th in the world).

However, those are not the only leading areas that provide opportunities for the existence of small- and medium-sized enterprises, start-ups or businesses run by entities or individuals. Defining a market gap where both larger and smaller businesses can find

employment creates a job opportunity for hundreds of thousands of people. Additionally, taking into account the current situation and European Union regulations, which force the closure of hard coal mines in Poland by 2050, the definition of such a gap in the raw material area may be an important opportunity for a safe transition.

3.2. Analysis of Current Trends in the Raw Materials Industry in Poland

Trend analysis involves the identification and quantitative description of key trends that have a significant impact on the performance of a company, industry, region or country. By studying trends, one can gather knowledge about prevalent threats and challenges, but also opportunities that may arise in the near future.

According to the literature, in Poland, the most innovative segments of the RM sector are mainly the following [42]:

- more precise methods and new technological solutions of locating, researching, drilling and exploiting the deposits and analyzing its parameters, in particular: oil and gas deposits.
- bioleaching—Extraction of metals without installing underground infrastructure (deeper seams).
- use of innovative technologies:
    - of difficult to quarry rocks extraction in coal mining,
    - for gasifying, co-incineration and transport (coal drying technology),
    - directed at limiting impact on the environment, of the trade of natural stones (extraction, processing and forwarding),
    - of oil processing,
    - that decrease the consumption of energy and work needed for extraction raw materials (clastic raw materials from flooded mine seams),
- process of underground gasifying of coal,
- use of new technological solutions:
    - for improving the technology of quarrying rocks by blasting,
    - improving the efficiency and industrial safety of basic machinery in mining,
- use of new methods of improving the calorific value of raw materials,
- use of modern tools for numerical modeling of newly built opencast mines,
- diagnostics systems and tools cause the limit of failure frequency of machinery and equipment,
- new systems for improving the safety of workers,
- reclamation of excavations.

The above characteristics of innovative areas do not necessarily coincide with the most popular areas that report the need for support. In order to isolate the ones which are currently the most popular, an analysis was made of projects that were implemented by research units from Poland (either independently or in partnership) in the years 2010–2019.

For each of the projects that were implemented between 2010 and 2019 with the participation of Polish scientific and research units, a list of these projects was made, along with a brief description and the keywords that defined this project.

The result is a list containing 108 items (108 scientific, research or development projects carried out in the field of mineral raw materials).

The analysis was based on a data set prepared by the authors. The data was collected from 108 scientific, research or development projects implemented in the area of mineral raw materials in Poland in the years 2010–2019. The following information was collected:

- Subject (officially notified to the relevant unit),
- Acronym,
- Date of project commencement,
- Date of project completion,
- Keywords of the implemented project.

Data on completed projects in the area of RM comes from several databases. These are as follows:

- Cordis, which is a database run by the Community Research and Development Information Service and is the main source of information on projects which are funded by the European Commission under the EU Framework Programmes for Research and Innovation (from FP1 to Horizon 2020) and their results. The mission statement of the organization and the operation of the database is to provide research results to experts in specific fields in order to support open science, create innovative products and services and stimulate growth across Europe. CORDIS is a rich and structured public repository containing all project information held by the European Commission, such as: project information sheets, participants, reports, results and links to open access publications,
- KIC—EIT Raw Materials. The European Institute of Innovation and Technology (EIT) was established in 2008 as the EU initiative to promote innovation and entrepreneurship in Europe according to the motto: united in diversity. The EIT brings together leading universities, research laboratories and companies to form dynamic cross-sector partnerships. These partnerships, called Knowledge and Innovation Communities (KICs), develop innovative products and services, start new companies, and train a new generation of entrepreneurs. They also bring new ideas to the market, turn students into entrepreneurs and introduce innovations. KIC initiatives address many societal challenges, including the EIT KIC Raw Materials, which aims to ensure the availability and sustainable use of raw materials for the benefit of the economy and the people,
- The National Center for Research and Development (NCBR) is a Polish government implementing agency; it is the key center for supporting and creating innovative technological and social solutions, and it creates a knowledge ecosystem and information on them. It initiates and implements projects contributing to the civilizational development of the country. NCRD aims to effectively support innovations in the Polish economy,
- The National Science Center (NCN) is an implementing agency established to support scientific activity in the field of basic research, i.e., empirical or theoretical work aimed primarily at gaining new knowledge about the foundations of phenomena and observable facts without aiming at direct commercial application.

4. Results and Discussion

The identification of the key area for entrepreneurship in the mineral raw materials sector in Poland was conducted on the basis of a keyword analysis. The keywords assigned to each project were analyzed. As a result, the frequency was determined, which proves the attractiveness of a given keyword originating from and representing particular projects implemented in 2010–2019 in the raw materials industry in Poland.

The preliminary analysis was based on two hundred keywords, and for each of which the frequency of occurrence in Internet search results was estimated (using the www.kwfinder.com (accessed on 25 July 2021) application). The next step was to aggregate those keywords which were classified as synonyms or very close terms.

The next step was to eliminate those results which received low search rankings. Finally, those with a frequency of occurrence greater than 500,000 were accepted for further examination.

The final step in this part of the research was to assign appropriate categories from the NACE classification to each keyword.

The operating algorithm in this methodology is shown in the diagram in Figure 3.

Table 1 provides a summary showing the keywords for each project, along with the frequency of occurrence and the NACE category assigned accordingly.

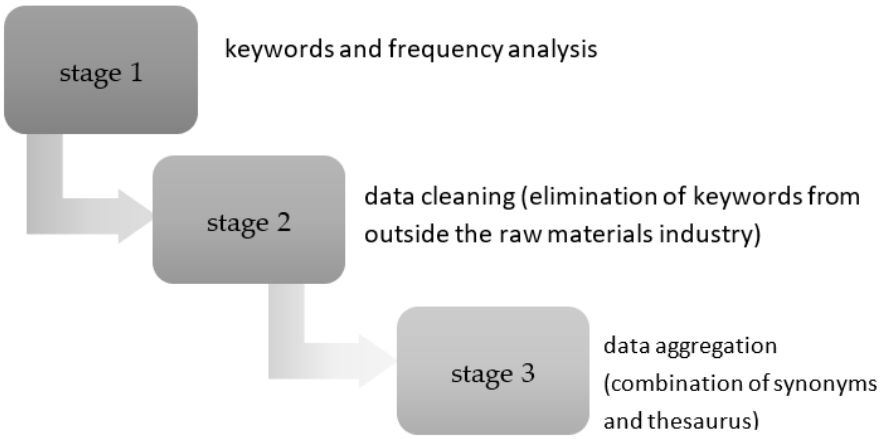

Figure 3. Research work stages in determining the market gap in the raw materials sector (own study).

Table 1. Matching keywords with relevant categories from the NACE (own study).

Keywords	Frequency	NACE
Access	970,000.00	activity related to IT software and consulting services and associated activity
big data	568,000.00	activity related to IT software and consulting services and associated activity
BIM	1,660,000.00	other professional, scientific and technical activities
Business	1,800,000.00	head offices activities; management consulting
Data	541,000.00	activity related to IT software and consulting services and associated activity
Development	601,000.00	other professional, scientific and technical activities
Education	911,000.00	education
Efficiency	545,000.00	head offices activities; management consulting
Energy	526,000.00	electricity, gas, steam, hot water and air conditioning supply
Environment	735,000.00	other professional, scientific and technical activities
Exploration	591,000.00	mining of hard coal and brown coal (lignite)
Gas	968,000.00	electricity, gas, steam, hot water and air conditioning supply
Internet	2,440,000.00	activity related to IT software and consulting services and associated activity
IT	3,850,000.00	activity related to IT software and consulting services and associated activity
Magnesium	775,000.00	other mining and extraction
Management	533,000.00	head offices activities; management consulting
Mining	580,000.00	mining of hard coal and brown coal (lignite)
mobile phone	1,040,000.00	manufacture of computer, electronic and optical products
Network	867,000.00	activity related to IT software and consulting services and associated activity
Pollution	515,000.00	remediation activities and other waste management services
Recycling	712,000.00	waste collection, treatment and neutralising activities; recovery of materials
Salts	710,000.00	other mining and extraction
Science	929,000.00	other professional, scientific and technical activities
Shafts	792,000.00	mining of hard coal and brown coal (lignite)
Software	977,000.00	activity related to IT software and consulting services and associated activity
Teaching	1,000,000.00	education
waste management	840,000.00	waste collection, treatment and neutralising activities; recovery of materials

Next, a map of potential market gaps was created based on the above market gaps.

In Figure 4, on the X-axis, the following keywords are listed under consecutive numbers. On the Y-axis, the subsequent positions are occupied by individual categories according to the NACE classification. The size of individual bubbles reflects the attractiveness of the concept, which can and should be interpreted as a market gap for potential entrepreneurs.

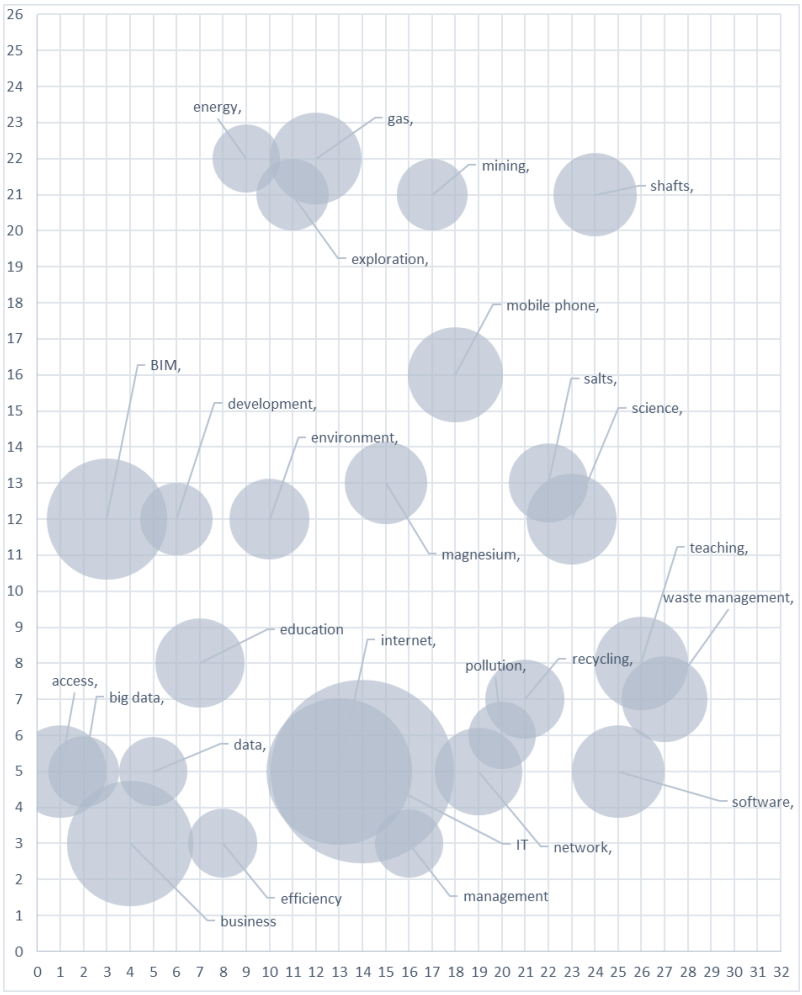

Figure 4. Map of market gaps diagnosed in the raw materials industry in Poland (own study).

On the X-axis, subsequent designations stand for: access, big data, BIM, business, data, development, education, efficiency, energy, environment, exploration, gas, internet, IT, magnesium, management, mining, mobile phone, network, pollution, recycling, salts, science, shafts, software, teaching, waste management.

On the Y-axis there are activities from the PKD classification, i.e.,:

- 3—Head offices activity; management consulting services
- 5—Computer programming, consultancy and related activities
- 6—Activity related to reclamation and other service activities related to waste management
- 7—Activity related to collection, processing and disposal of waste; raw materials recovery
- 8—Education
- 12—Other professional, scientific and technical activity
- 13—Other mining and extraction
- 16—Manufacture of computers, electronic and optical products
- 21—Distinguishing hard coal and brown coal (lignite)

- 22—Manufacturing and supplying electricity, gas, water steam, hot water and air for air conditioning systems.

The analysis shows that the largest area on the chart is occupied by the keyword IT, followed by Internet and business. By organizing the analysis and assigning the selected keyword to the PKD (NACE) classification, we will obtain the following industry dedicated to new economic activities in the area of mineral resources: software and IT consulting activities and related activities. It is closely connected with Industry 4.0, that is entering the Polish market, and with widely understood ICT technologies.

The most innovative areas in the future in the ICT sector in Poland are the following:

- technologies: of artificial intelligence for manufacturing systems, intelligent sensor network, semantic network and RFID (radio-frequency identification) technologies,
- systems of: special navigations, observation and identification (different ranges of electromagnetic waves from visible light and infrared), cyberspace protection (eradicating risks by developing IT infrastructure), infrastructure and technologies of the distributed systems for e-business and of logistic support and supply chain management, intelligent control traffic.

The next positions in the analysis were occupied by: Internet and business. They are complementary, so to speak, to the IT that emerged in the first place. The Internet is closely related to it and, in the face of the prevailing pandemic, it has probably become even more important for doing business in every industry, including the raw materials industry. Moreover, the keyword business has such a broad application that it encompasses all processes related to business.

The identification of a market gap in the area of the raw materials industry in Poland may serve as a guideline for future investors (start-ups, businesses, companies) concerning making decisions about launching a business or its direction. Additionally, the analysis highlighted the direction in which the raw materials sector in Poland will change. The changes, which are a necessity and result, among others, from European Union regulations, will force such changes on the Polish raw materials market. The support of science (as evidenced by the number and type of projects carried out) may contribute to the dynamic development or expansion of the IT industry in the raw materials industry.

Surely, one might also spot risks for potential investors, namely market uncertainty or changes of legal regulations, social unrest, pandemics—these are just a few examples of factors that can significantly contribute to changes or disruptions in the activities of the new entities. In order to explore the issue further, the authors have developed an extensive PESTEL analysis, both for the raw material market in Poland and for the IT area in the raw material sector (the results of this analysis will be published in further works of the Authors).

The raw materials industry in Poland is very broad (see Chapter 1). In each of the NACE activities in this industry, one can find conditions characteristic of this industry. What is more, the conditions occurring in the industry in Poland are different to those in other countries. This is proved by the research carried out in selected countries of the Visegrad Group—Hungary and Slovakia. In each of them, a similar conclusion concerning the market gap in the raw materials sector was made. Furthermore, in each of these countries, this gap was different. The Slovak raw materials market has potential for new entities and investors in the construction of buildings sector, while the Hungarian market has potential in the waste management sector (information from an ongoing research project—unpublished data). This research confirms the necessity to look for market gaps in domestic markets, taking into account all country-specific factors.

5. Conclusions

The raw material market in Poland affects the functioning of the entire national economy. It is currently in a difficult situation. Although its functioning has become unstable in recent years, it still plays a critical role in the development of many industries.

The review of mineral resources in Poland has shown that the country has relatively large and diversified mineral resources.

The purpose of the article was to identify the market gap for business for entities or individuals in the mineral resources sector in Poland. Taking into account the European Union regulations which enforce the closure of hard coal mines in Poland by 2050, it is reasonable to identify such a gap in the raw materials area, especially since the current situation may turn out to be a new revival of the raw materials market after the pandemic period.

Firstly, based on the NACE classification, a key area was identified, which is dedicated to potential entrepreneurs in the mineral resources area. Based on an internal analysis, the sectors directly related to the RM field in Poland were distinguished. Narrowing down the analyzed sections, leading areas were indicated that offer significant employment opportunities for hundreds of thousands of people who will be made redundant (often in groups) as a result of the phasing out of hard coal mining in Poland. The identification and analysis of key trends that have a significant impact on the functioning of an enterprise, an industry, a region or a country identified threats and challenges, but also opportunities that may arise in the nearest future. In addition, a number of scientific, research or development projects carried out in the mineral resources area between 2010 and 2019 were analyzed.

A keyword analysis assigned to each project was used to find the key area for entrepreneurship in the mineral resources sector in Poland. For each keyword, the frequency of occurrence was determined and aggregated, and then the keywords that were assigned low levels of attractiveness were eliminated and assigned the appropriate NACE categories. As a result, a map of potential market gaps was created which indicated that IT, Internet and business were the most attractive in RM.

The research and analysis clearly indicated that activities related to software and IT consulting and related activities are primarily dedicated to new business activities in the mineral raw materials sector in Poland. This is related to widely understood ICT technologies and Industry 4.0, which is entering the Polish market on a strong note. The results presented provide many opportunities for students looking to start their businesses in the mineral sector. Broad prospects for the emergence and growth of new start-ups are provided by the diverse areas of ICT activity. Industries that may have potential in the RM sector in Poland include smart sensor network technologies, spatial navigation systems, cybersecurity systems, countering threats by developing hardware infrastructure, intelligent traffic control systems, RFID (radio frequency identification system) technologies or artificial intelligence technologies for manufacturing systems.

The authors hope that their contribution consisted in: analyzing the current state of the mineral raw materials in Poland and its environmental trends or legal conditions, presenting the possible directions for the development of this industry and the gap indicated in the article, which may contribute to a faster and more efficient reconstruction of the raw materials market in Poland; moreover, the necessary financing and innovations introduced will ensure the competitiveness of the national economy and the energy independence of the country, as well as the safety of miners' work and environmental protection.

A limitation of the analysis could be the scope of the implemented projects in the field of RM in Poland (2016–2021), although the authors wanted to show the most current status of the projects that are implemented with the participation of Polish research units.

The analysis shows the direction (IT, ICT) of both new and already existing entities carrying out activities in the raw materials sector. It also provides guidelines to the scientific world on where to carry out research, look for new solutions and change the industry in accordance with new technologies and methods. This statement may be supported by the research already started by the authors, consisting of the analysis of companies operating in the RM sector and the Pestel analysis for both the raw materials market in Poland and the IT area in the raw materials sector. A suggestion also for people who would like to focus on such issues in their scientific works could be to conduct interviews with entrepreneurs and students of raw-material-related fields. This could provide the answer as to whether

they have an idea for their own business in the RM sector or see the chance to diversify their activity, or whether they have just set up their own business.

Author Contributions: Conceptualization, M.S., B.K. and P.B.; methodology, M.S., B.K. and P.B.; software, M.S.; validation, M.S. and B.K.; formal analysis, B.K.; investigation, M.S., B.K. and P.B.; resources, M.S., B.K. and P.B.; data curation, M.S.; writing—original draft preparation, M.S., B.K. and P.B.; writing—review and editing, B.K.; visualization, M.S., B.K. and P.B.; supervision, B.K.; project administration, B.K. and P.B.; funding acquisition, M.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research was prepared as part of AGH University of Science and Technology in Poland, sci-entific subsidy under number: 16.16.100.215.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study was the subject of research by an international team in the LIMBRA project, Decreasing the negative outcomes of brain drain in the raw material sector, EIT Raw Materials, KIC Project Number 18197.

Conflicts of Interest: The authors declare no conflict of interest.

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