

## Article

# Overview of Taken Initiatives and Adaptation Measures in Polish Mining Companies during a Pandemic

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**Abstract:** The emergence of the new SARS-CoV-2 virus two years ago strongly affected economic life and labour markets around the world. The pandemic affected many sectors, including the mining industry. Coal companies have had to cope with the challenges and adapt their operations to the situation. Due to the peculiarities of the mines, not only to the hazardous factors and conditions prevailing underground but also to the large number of employees who usually move in groups in the plants, the emergence of a new threat caused by a biological agent posed a real challenge for them. The aim of this paper was to present the initiatives and measures taken in the coal mining sector to ensure the safety of workers during a pandemic. The guidelines for the operation of mining plants during the SARS-CoV-2 epidemic were analysed, as well as the identification of locations in mining plants particularly vulnerable to infection with the virus. We also presented how the pandemic period affected the operations of a selected coal company in Poland from an economic point of view.



**Citation:** Kowal, B.; Ranosz, R.; Herezy, Ł.; Cichy, W.; Świniarska, O.; Domaracka, L. Overview of Taken Initiatives and Adaptation Measures in Polish Mining Companies during a Pandemic. *Energies* **2022**, *15*, 6403. <https://doi.org/10.3390/en15176403>

Academic Editor: Adam Smoliński

Received: 30 July 2022

Accepted: 30 August 2022

Published: 1 September 2022

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**Keywords:** COVID-19; pandemic; mining sector; initiatives and adaptation measures; economic situation

## 1. Introduction

“Maintaining occupational safety in mining has been one of the important objectives of its operation for decades” [1]. Both the deposits of raw materials and the ongoing activities of mining companies aimed at extracting a useful, energy-generating mineral such as hard coal are characterised by peculiarities [2,3]. Conducting works in the rock mass is burdened with high risk, mainly due to the possible occurrence of natural hazards (methane, rock bumps, fire, water). Therefore, the operation of mining companies and the execution of individual works are based on a number of procedures. Since it is the task of the employer, who has legal obligations, to create a safe working environment, i.e., to ensure the safety of all employees, especially those working in underground workings—it is most important that procedures are followed [1,4].

In late 2019 and early 2020, the new SARS-CoV-2 virus, which causes the COVID-19 respiratory disease, began to spread worldwide. The virus reached Poland two years ago, in March 2020. Time has shown how dangerous this disease can be, having a very severe course with subsequent complications and possibly even leading to the death of infected individuals. The occurrence of this epidemic threat in Poland and the rapidly increasing number of infections meant that the government had to introduce many restrictions, which not only limited the activities of the public to date but also affected the operation of many businesses, including those in the mining sector.

Border closures, halting investments or the economic downturn, as well as a drop in demand for the raw material produced and reorganisation of work were just some of the difficulties faced by the mining industry during the epidemic. Despite the existence of the

Act of 5 December 2008 on the Prevention and Control of Infections and Communicable Diseases in Human Beings by Epidemiological Threats and the need to take the preventive measures set out in Article of the Act, the industry was not prepared for a threat of this nature and magnitude. This was due to the fact that there had not been an epidemic of this magnitude in the past few decades and there had been no efforts to develop procedures for the operation of companies and the actions they would take in the event of a biohazard. The biggest problem it had to face was ensuring a sense of security for its employees and their relatives, as the fear emerging among employees at the time resulted in their absence from work, as well as a lack of ensuring the continuity of plant operations. The challenges posed to mining companies during the coronavirus outbreak were framed in three areas [5]:

- Economic (including the withholding of many investments, a decline in demand for the raw material produced, loss of strategic customers, loss of liquidity, a reduction in employee wages, a decline in the company's stock market value and the need to find additional capital to purchase protective measures for employees);
- Organisational (e.g., limiting contact between employees to the minimum necessary, organising underground transport in accordance with the guidelines for the number of people, reorganising working hours, introducing remote working for some positions, supplying mines with an adequate amount of protective and disinfecting agents, organising teams to supervise the disinfection process of premises and workplaces, the need to temporarily ban external stakeholders from entering the mine site);
- Health-related (e.g., problems with access to protective equipment, insufficient quantity in the initial phase, workers' fear of illness, organisation of medical points or preparation of workplace accident management).

The management of companies and mining plants had to meet the aforementioned challenges and develop rules and procedures which, on the one hand, would ensure economic security and continuity of planned investments to maintain operations [6,7] and also guarantee a sense of calm and security for all employees performing their tasks during an epidemic. Developing a strategy for mining companies in the event of an epidemic crisis is a difficult, complex and intricate task, all the more so given the impossibility of completely shutting down underground mining operations for the duration of a pandemic (huge material losses and even the need to shut down the plant in question). The situation that arose in 2020 can be said to have been a crisis of sorts for the energy sector and the hard coal mining industry in particular, inter alia, due to the need to cope with many difficulties at the same time, both economically, organisationally and epidemically. A responsible and sustainable approach to the changes implemented and the mine's operating strategy during the pandemic ensured that high standards were maintained in the ESG (environmental, social and governance) areas. The companies took a comprehensive approach to the emergency response mechanisms put in place while maintaining sustainability and corporate social responsibility objectives.

This paper presents a description of the functioning of mining companies in Poland during the epidemic crisis, with particular emphasis on how mining companies coped by introducing a number of initiatives and adaptation measures. A breakdown of the initiatives is presented according to the ESG pillars (environmental, social, governance). The authors also discussed selected economic and social impacts of the COVID-19 pandemic in the energy sector using the example of the coal mining sector.

In the last two years, the mining sector has worked on recommendations to overcome the consequences of the pandemic. First of all, this article is a literature review of the recommendations that have been developed and adopted by Polish mining companies. Secondly, which is the contribution of the authors, we present a description of the functioning of mining companies in Poland during the epidemic crisis and show what has been done in some mining companies in Poland and how they coped by introducing a number of initiatives and adaptation measures. The breakdown of initiatives is presented according to the ESG pillars (environmental, social, management). Further research focuses on a

particular mining company LW Bogdanka S.A. The authors also discussed the selected economic and social effects of the COVID-19 pandemic in the analysed sector.

## 2. Literature Review

The raw materials sector, and in particular the hard coal sector, plays a key role in the Polish economy [8]. The applicable regulatory provisions of the European Union and the transition of the sector from a traditional to a low-carbon economy have started to pose increasing challenges to companies in the mining sector, which are, at the same time, the difficulties faced by the sector today [9–17]. It is not only about meeting environmental requirements or reducing greenhouse gas emissions; it is also about social and economic challenges. The implemented policy of decarbonisation of the Polish economy also means a reduction of both products in power coal mining and the liquidation of jobs [8,18]. These difficulties were joined two years ago by the pandemic caused by the SARS-CoV-2 virus.

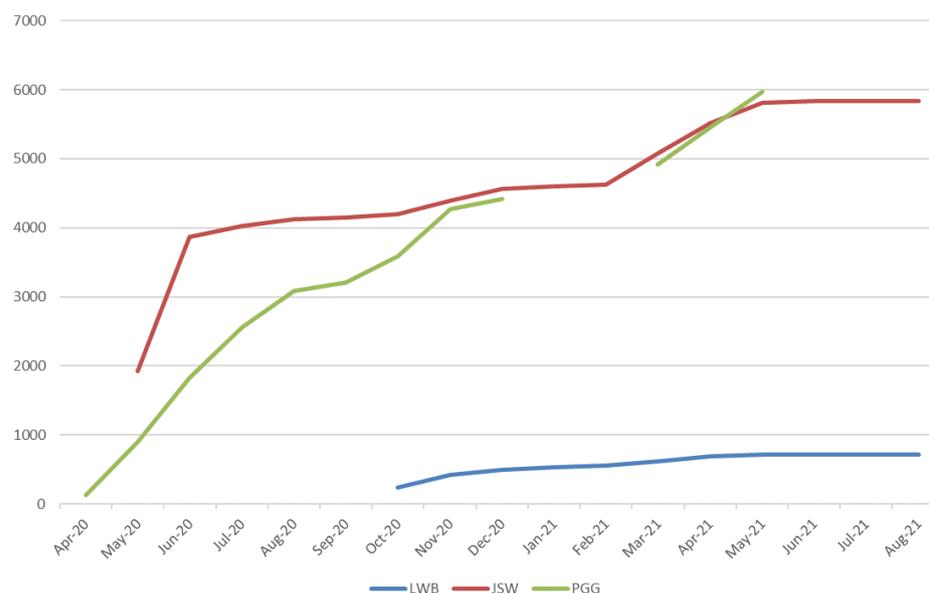
“COVID-19 dealt a devastating blow to the global economy” [8,19]. The energy sector (along with the mining sector) is the primary economic development industry of most countries and has been battling a global pandemic since 2020 [20–23]. The emergence of the COVID-19 pandemic affected the mining sector very quickly and unexpectedly [22].

A number of studies can be found in the literature outlining the impact of the pandemic on the energy sector and its sustainability. Siksnyte-Butkiene [24] identified five areas affected by the pandemic (energy consumption and demand, air pollution and quality, investment in new renewable energy projects, household energy poverty and energy system flexibility). In turn, Gersdorf T. et al. [25] signalled that the pace and magnitude of pandemic-influenced corporate change could be analysed in areas such as the macroeconomic environment, technology and infrastructure, electric vehicle offerings and demand. A study by Kumar A. et al. [26] emphasised the link between pandemic and greenhouse gas emissions, the air pollution index was also the subject of work by [27,28], and in Lu H.F. et al. [29] highlighted the impact of the pandemic on energy demand and prices, energy policy issues and countermeasures. In the papers [30–32], one can find the impact of the evolution of the pandemic on the level of electricity consumption. Some studies also focus on assessing the level of energy poverty during the pandemic [33–38]; others analyse the impact of the pandemic on the energy expenditure of local government units in Poland [39]. In the literature, it is difficult to find broader, aggregate studies on the conduct of mining plant operations under conditions of epidemic risk. Most are short articles on the websites of individual coal companies.

It should be mentioned that the main strength of the hard coal sector is people or human capital [40]. Mining companies employ a huge number of workers who perform their work down in the mines and on whom the situation of the mining plants depends. Figures provided by the Higher Mining Office show that in 2020 (data as of 31 December 2020), there were a total of 72,234 own employees in 21 coal mines, and 28,986 in service companies, making a total of 101,220 mining plant employees. In addition, the structures of Spółka Restrukturyzacji Kopalń S.A. (including service entities) had 2342 employees [41]. On the other hand, in 2021 (data as of 31 December 2021), a total of 68,081 own employees worked in 20 coal mines and 26,381 in service companies, making a total of 94,462, while 2246 employees worked in Spółka Restrukturyzacji Kopalń S.A. [42]. As can be seen, mines are concentrations of people and their work underground takes place in difficult as well as dangerous conditions in which the SARS-CoV-2 virus could spread quite rapidly. Therefore, the most important thing during this difficult period was to ensure an adequate level of health and safety for all employees [1,43].

The outbreak of the global pandemic has meant that mining operations have had to reorganise their existing operating rules to combat the bio-threat caused by the coronavirus effectively. The scale of the problem could be seen when it was reported that by 10 July 2020, i.e., during the four months of the pandemic, more than 6500 workers had been infected with the coronavirus in total from mines located in Silesia. The only mine where no infection was reported was LW Bogdanka S.A.

A summary of the number of infections in the three coal companies shows how the number of new cases developed during the initial periods of the pandemic (Figure 1).



**Figure 1.** Comparison of infection models in three selected coal companies in Poland in the period from April 2020 to August 2021.

The epidemiological crisis in the coal mining sector began in March 2020. At that time, the first Crisis Staff in mining companies started to be established. The first cases of coronavirus infection in mines in Poland emerged in April. In Polska Grupa Górnicza SA (PGG SA), the first case was reported on 16 April 2020 at the Jankowice mine in Rybnik. The situation was similar at Jastrzębska Spółka Węglowa SA (JSW SA), where the first case of infection occurred on 26 April 2020 at the Pniówek mine. In contrast, the first cases at LW Bogdanka S.A. were not reported until 7 October 2020 (Figure 1).

In the presented model of the course of infections in the Polska Grupa Górnicza, it is possible to observe the individual waves in which the SARS-CoV-2 virus attacked with increased activity. From 20 March to 21 June, 1836 infections were recorded in the Polska Grupa Górnicza. This represents 30.41% of all infections that occurred at Poland's largest mining company. The holiday months are particularly noteworthy. Approximately 1450 new cases were recorded then, accounting for 24% of all infections during the pandemic. The situation was significantly different for the whole country during the second wave, which took place in autumn 2020. At that time, 971 infections were reported in the Polska Grupa Górnicza, when there were already more than 120,000 infections in the entire Silesian Province since the beginning of the epidemic. At the end of December, counting from the beginning of the epidemic, there were already 4412 employees infected. The situation was much worse during the third wave of the coronavirus epidemic. At that time, 1564 workers were infected, 26% of the total number of infections.

At JSW SA, which employs less than 23,000 people, representing 29% of all employees in the coal mining industry, 5358 infections have been detected since the beginning of the epidemic.

This shows that 23.2% of all employees had infections in the period presented. In the case of this company, an increase in SARS-CoV-2 virus activity can be observed. The vast majority of infections were recorded during the first period of the epidemic. From 26 April 2020 to 21 June 2020, 3840 workers were infected, representing 65.8% of the total number of infections since the beginning of the epidemic. Only 306 workers were infected during the holiday period. During the second epidemic wave of the coronavirus, 452 employees became ill at JSW SA, representing 7.7% of all infections contracted. During the third epidemic wave, 1237 infections were recorded, representing 21% of all infections in the

company. From June to August 2021, not a single case of infection was detected. According to communications from the Press Office of Jastrzębska Spółka Węglowa, the vast majority of infections among employees were asymptomatic.

At LW Bogdanka S.A., the number of infected workers was definitely low compared to the previously described companies. The ratio of coal mine infections to the total number of cases in Poland has changed over time in favour of the mining industry. The case of LW Bogdanka S.A. is quite interesting due to the fact that the first case in this coal company appeared much later. Therefore the authors decided to analyse the initiatives taken by this company.

During the pandemic, companies took a number of measures to prevent and minimise the risk of workers becoming infected (described in Section 4.3). These measures helped to mitigate the consequences of the pandemic, but before the first wave of the coronavirus outbreak could be contained, a decision was taken in some mines to stop mining for two or three weeks. Such decisions were due to the sudden increase in infections. At the time, the mines were operating with minimal occupancy to protect the pits from existing water, fire, methane or other hazards. The companies also conducted vaccination campaigns, during which a large number of employees (with their families) were able to receive a dose of the vaccine.

### 3. Materials and Methods

The main objective of the study was to present the initiatives and activities undertaken in the hard coal mining sector in terms of ensuring the safety of employees during a pandemic, taking into account their economic and social consequences.

As part of the research undertaken by the authors to achieve the main goal of this article, specific goals were set, which were related to:

1. Analyse the guidelines for the operation of mining plants during the SARS-CoV-2 epidemic;
2. Analyse miners' behaviour in relation to the introduced restrictions;
3. Identification of sites in mining plants particularly exposed to virus infection;
4. Review of actions taken and initiatives by the selected coal company;
5. Indications and analyses of the effects of a pandemic from the social and economic perspective.

To respond to the set research goals, we used qualitative methods in the research, in particular:

- Analyse publicly available materials, reports and publications on the pandemic in the mining industry,
- Analyse orders and procedures in force in coal companies during the pandemic,
- IDI—In-depth interviews with representatives of mines, mining companies and industry experts, in which we supplemented the previously obtained information,
- Analyse materials and data provided by the mining company,
- Analyse industry and sector data regarding mining and the analysed company contained in the EMIS database.

### 4. Results and Discussion

This section has been divided into five parts in accordance with the objectives of the article: analysis of guidelines for the operation of mining plants during a pandemic, identification of sites particularly vulnerable to virus infection in mining plants, review of actions taken and initiatives by a selected mining company, and analysis of the effects of the pandemic in terms of economic and social.

#### 4.1. Guidelines for the Operation of Mining Plants during a SARS-CoV-2 Outbreak

The outbreak of the pandemic worldwide also meant that mining operations had to reorganise their existing operating rules to combat the bio-threat caused by the coronavirus effectively. The scale of the problem could be seen when it was reported that by 10 July

2020, i.e., during the four months of the pandemic, more than 6500 employees had been infected with the coronavirus in total from mines located in Silesia. The only mine where no infection was reported was LW Bogdanka S.A.

Mines are specific workplaces mainly because of the dangerous factors and conditions that occur in their working environment. With the emergence of a new threat caused by a biological agent in the Polish mining industry, certain measures have been taken to ensure the safety of workers in mining plants and service companies.

The Chief Sanitary Inspector, together with the Minister of State Assets, prepared guidelines for the operation of mines during the SARS-CoV-2 outbreak. The recommended guidelines were aimed at managing the difficult epidemiological situation faced by mining plants in spring 2020 (March 2020). The procedures developed for this purpose were primarily aimed at limiting the spread of the virus by reducing the number of contacts on the premises, as well as organising work in such a way as to maintain the proper functioning of mining plants [44]. The Chief Sanitary Inspectorate (GIS) issued recommendations for the operation of industrial plants during the epidemic threat. These were divided into three groups: prevention, containment and emergency management.

Key recommendations and procedures to limit the spread of the virus included [44,45]:

- providing workers with the means to protect their mouths and noses and covering them compulsorily were indicated by law; this obligation applies to all suppliers and visitors moving on the premises;
- use of distance barriers (e.g., glass, plexiglass to protect the worker from the possibility of infection from sick persons);
- maintaining a safe distance between workstations (1.5 m) as far as possible;
- reducing the number of working shifts and reducing working hours to six hours, use of distance barriers (e.g., glass, plexiglass to protect the employee against the possibility of infection from sick people);
- reducing contact between employees (changing the work system and identifying where employees congregate, introducing remote working where possible, halving the number of people entering the shaft hoist cage and being transported by transport equipment, and increasing the number of descents in shafts);
- restricting the use of communal spaces (different break times, closing canteens or limiting the number of people who can be there, the possibility of a breakfast break at the workstation, limiting the number of people using the baths);
- use of routine personal protective equipment by underground workers;
- updating cleaning and preventive decontamination procedures for rooms and areas (e.g., circulation paths, offices, cloakrooms, sanitary rooms, lamp rooms, refreshment points, stairwells);
- displaying instructions in the sanitary and hygiene rooms on hand washing, donning and doffing masks and gloves;
- suspension of periodic in-house training and introduction of online training;
- limitation of external cooperation;
- staff briefings should take place in an open space and meetings and deliberations, if necessary, with windows open;
- designating crisis management centres that make decisions depending on the situation.

Detailed guidelines for the aforementioned procedures have been developed by the Emergency Management Team at Underground Mining Plants (Polish: Nadzwyczajny Zespół ds. Zagrożeń w Podziemnych Zakładach Górniczych) appointed by the President of the State Mining Authority.

In addition to these key procedures, precautionary procedures have also been developed outlining the course of action to be taken if an infection is suspected in any of the employees. These included such provisions as [44]:

- if there are symptoms of infection, workers should not come to work,
- an employee who has developed symptoms of infection should report to the nearest sanitary-epidemiological station,

- introduction of non-contact temperature measurement before entering the establishment; if a temperature above 37 degrees Celsius or if a person is observed to have a persistent cough, malaise or difficulty breathing, such a worker should not be allowed to enter the establishment,
- preparing the room to isolate the worker who develops symptoms of infection,
- prominently displayed numbers for medical services and sanitary and epidemiological stations.

Of course, if a worker is diagnosed with the virus, the recommendations of the state health inspector must be followed, and in particular: it is necessary to determine in which area of the plant the infected worker has moved to carry out decontamination in accordance with company procedures, identify a list of employees or customers with whom the infected person has had contact, and, if production has to be completely stopped, it is advisable to maintain critical infrastructure for the proper maintenance of the mining plant. The introduction of adaptation measures initially did not have the expected results. The number of infections continued to rise and managers of mining plants decided to introduce organisational changes to reduce the number of workers in the cages of shaft lifts or transport machinery, among others. Mass screening was carried out at a number of plants, but as the situation did not improve and the number of infected continued to rise, the government decided to suspend work at twelve mines for three weeks completely. After this period, as of 6 July 2020, all mines returned to normal operations (but with all the 50% restrictions respected). It can be concluded that the period of suspension of the mines was crucial and had an effect. Difficult, from an economic point of view, decisions influenced the control of the situation and stopped the growth of infection. From the beginning of July 2020, with the continued adherence to the developed guidelines and the ongoing adaptation measures in the mines, the extinction of the coronavirus outbreak and the suppression of its growth in the coal mines became apparent.

In addition, in 2020, the Higher Mining Authority (WUG) carried out 1206 inspections to check the state of safety in the operation of mining plants and how the recommendations on procedures for dealing with epidemic risks are implemented at these plants [41,42]. These inspections did not reveal any irregularities.

#### *4.2. Need to Identify Plants Particularly Vulnerable to Coronavirus Infection*

The emergence of the new virus in Poland posed a huge threat to mining plants. This is because they are specific workplaces where large concentrations of people gather at the same time. Due to the specific nature of the SARS-CoV-2 virus, which spread very quickly and persisted for a long time on surfaces, close contact of workers with each other could prove very dangerous. The virus causes acute respiratory illness that can even lead to death. It was, therefore, a major challenge for managers to organise miners' work in such a way that the risk of infection was minimal. There are many such areas in mining plants where there is increased social contact between workers. Thus, they are exposed to a higher risk of contracting coronavirus. Mines, through the limited possibilities related to the specific infrastructure, the nature of the work carried out and the existence of so-called common areas within the plant where large numbers of people congregate at one time, have faced an extremely difficult challenge regarding compliance with the rules of imposed spatial distance (1.5 m spacing between workers).

Due to the specific nature and potential for the spread of the virus, places particularly vulnerable to coronavirus infection have been identified. Such public places, where many workers congregate and the risk of infection is increased, include:

- employee transport;
- entrance/exit gates;
- main traffic routes;
- guildhalls—Places where work is shared;
- sanitary and hygienic facilities;
- lamp room;

- above the shaft and below the shaft—Places where the crew goes down and up;
- underground transport by passenger trains and overhead rail;
- beverage dispensing points.

Employee transport is used by local residents who work at the same mining plant but in different departments. When transport is shared, there is an increased possibility of the virus spreading and in an uncontrolled manner. The Decree of the Council of Ministers of 6 May 2021 on the establishment of certain restrictions, orders and prohibitions in connection with the outbreak of an epidemic—on collective transport of more than nine persons says [46]: “by a given means of transport or vehicle, no more persons may be transported, at the same time, than 100% of the number of seats or 50% of the number of all seating and standing places specified in the technical documentation or the technical and operating documentation for a given type of means of transport or vehicle while leaving at least 50% of the seats unoccupied in the means of transport or vehicle”. This means that an employee transport (coach) with 52 seats, according to the technical and operating documentation, could only be used by 26 employees.

The second dangerous area is the main entrance/exit gates. Each employee has to bounce a card at the gate, in the room where the time readers are located. During the start hours of the first shift, up to 1000 people pass through the gate within 20 min. Due to the introduced requirement to measure temperatures, disinfect hands and maintain a 1.5 m queue distance at the entrance, there could be considerable congestion before entering the plant. These resulted in employee delays at the workstation.

The infrastructural constraints in the plants (a large number of workers at one time) also apply to the main circulation routes. These are mostly narrow corridors that connect: offices, guild halls, baths, as well as refreshment points or lamp rooms. Before the start of work (before each shift), the passageways are used by a very large number of miners (most before the first shift) in the 30 min prior to the descent. The passageways are, therefore, a huge obstacle to maintaining the required distance between workers and are a particularly vulnerable place for virus infection.

Another place in mines where a lot of workers congregate are the guild halls, where the offices of all the divisions are located and where the division of work and duties for the miners takes place before each of their descents. The nature of work in a mine means that the mine foreman assigns to the workers each time the tasks and duties that await them on a given day.

It is only in the guildhall, i.e., the miners’ changing room (Figure 2), just before the ride down, the miner learns which area of the mine they have to go to on a given day, what task they have to perform and what equipment they need to prepare to carry out the order (electric meters, oxygen sensors, specialised tools taken from the surface).



**Figure 2.** A guildhall in LW Bogdanka S.A. Source: photo provided by LWB.

The sanitation and hygiene facilities, which include chain baths and showers, can be the most challenging (Figure 3). Before descending, workers leave clean clothes on the clean side of the chain bath and walk to the other side, where each worker has their own hook with work clothes. This system of hanging up clothes allows all clothes to dry well after finishing work. However, the nature of the bathhouse during the epidemic posed a serious risk. Mainly because of the very high accumulation of workers in the bathhouse compartments. The distribution of workers in the bathhouse is not orderly in terms of ward and work areas. Workers from the surface, longwall, face and workshop departments may meet in the same compartment. If an infection was detected in any of them, there was a high probability that the rest of the workers were also infected.



**Figure 3.** A chain bath in LW Bogdanka S.A. Source: photo provided by LWB.

In turn, the place where workers meet (both before and after the descent) is the lamp room (Figure 4). From this place, underground mine workers retrieve the necessary equipment for the task, i.e., escape apparatus, oxygen detectors, front mining lamps and personal protective equipment, among others. The number of people picking up and putting down equipment at the same time, as well as the narrow aisles between lamp loading stations or escape apparatus shelves, make the lamp room an impossible place to maintain a 1.5 m distance. This is related to an infrastructure that does not allow for the reorganisation of stations (the lamps are at a very short distance from each other) and the workers tend to be close to each other.



**Figure 4.** A lamp room in LW Bogdanka S.A. Source: photo provided by LWB.

An extremely important place in any mine is the top and bottom of the shaft. This is where the descent and departure of the crew takes place. Each shaft has a separate area

where the workers wait for their turn to descend. On the other hand, there are waiting areas in the shaft where miners go as soon as a passenger train or overhead train arrives. This is a walkway where benches have been built so that the crew can wait quietly for their departure. Figure 5 shows the waiting and entering of the cage miners.



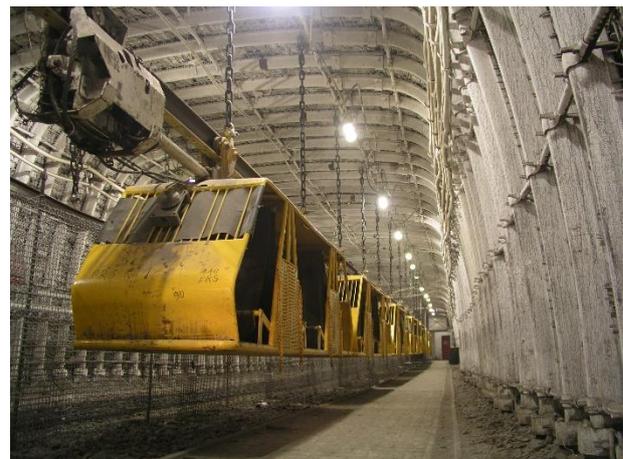
**Figure 5.** A coal mine top shaft in LW Bogdanka S.A. Source: photo provided by LWB.

In addition, mention should be made of the regular descents and ascents that take place by the mine shaft hoists of the mine plant using a shaft cage known as a “shola” or hoisting vessel. The cage has several floors, usually 2 to 4. The permissible number of persons per floor, depending on the number of floors of the vessel, varies (the most common is 16–20 persons for a cage with four floors and two hoisting vessels and 40–50 persons for a cage with two floors and one hoisting vessel. The cages have a small space where workers stand one next to the other.

A key issue to ensuring the smooth operation of any mining facility is the underground transport of workers. The infrastructure associated with underground transport includes passenger stations, waiting for areas for transport and various means of transport, depending on conditions and needs (Figures 6 and 7).



**(a)**



**(b)**

**Figure 6.** Underground transport means used in LW Bogdanka S.A.: an underground railway passenger carriage **(a)** and overhead passenger cabin/rail **(b)**. Source: photos provided by LWB.



**Figure 7.** Underground transport means used in LW Bogdanka S.A.—Belt conveyor for transporting people. Source: photo provided by LWB.

Most often, workers are transported to the various areas of the mine either by mine underground rail (Figure 6a), by overhead rail (Figure 6b) or by the special bench. In some cases, people are also transported by specially adapted belt conveyors (Figure 7).

The passenger rolling stock can carry more than 140 people to the work area. One passenger wagon accommodates 12 people in a small space, and there can be up to 12 or 13 carriages coupled together.

A typical wagon is just under 4 m long and about 1.4 m wide. The space of the wagon is divided into three compartments, each accommodating four people. This puts those workers at risk of infection on the way to or from the workstation. The railway moves along a crosscut—A horizontal corridor excavation. During transport, there is also a high turnover of workers from different departments, who wait in narrow galleries for the train to arrive and then swap with the crew who have arrived for the next shift in the mine area. These circumstances mean that transport by underground rail, especially during the epidemiological crisis, posed a high risk of infection among workers.

The second most common underground means of transport are overhead railways. The nature of their work makes it possible to negotiate numerous inclines, i.e., workings with an inclination of up to 45°. The trains often supplement underground rail transport. Transport by overhead rail can be using passenger cabins or passenger transport benches. Cabins are usually eight-seaters. Personnel transport is carried out in two-person compartments. The length of the cabin is approximately 4 m and the width is a maximum of 1.1 m. Up to five cabs can be connected together, giving the possibility of transporting 40 workers to the workplace.

Workers are also transported by a different type of passenger overhead rail, which is a passenger bench. It is approximately 3.5 m long and less than one metre wide. It can carry up to 8 people. Like the overhead rail, the passenger bench complements underground rail transport. It can negotiate gradients of up to 30°.

The last identified location with a risk of contracting the virus was at the beverage dispensers. Standing in close proximity to a queue and using one water dispenser could also have resulted in the spread of the virus.

The so-called “common places” in the mining establishments shown represent places where workers are particularly vulnerable to infection with the SARS-CoV-2 virus. The situation that occurred in 2020 required appropriate action on the part of the management of the mining companies (employers) to ensure the safety of all workers, as well as to ensure continuity in the operation of the establishments. Mining companies were forced to take many initiatives and measures to adapt to the new emergency situation.

#### *4.3. Adaptation Initiatives and Activities Undertaken at a Selected Mining Company*

It should be mentioned that the last two years of operation of mining plants have taken place during an epidemiological crisis. Every crisis is a worrying phenomenon for

an organisation, especially as it is the result of unplanned events. The undertaking of various activities, initiatives or recommendations, both by the Boards of Directors and by the Crisis Staffs established in the mining companies, took place in conditions of the high risk associated with the increase in infection among the crews and uncertainty as to the effects of the initiatives undertaken by them. The mining companies took many anti-crisis measures during this period. These measures were preventive and adaptive to the situation. Their aim was to limit the spread of the virus within the sites and to reduce the incidence of COVID-19 among mine workers.

The actions taken and implemented over the last two years at a selected mining company in Poland, which was LW Bogdanka S.A., are presented. A summary of the measures is presented in Table 1. According to the new corporate governance rules, the so-called Best Practices 2021, companies listed on the Main Market of the WSE are required to develop a business strategy that takes into account environmental, social and governance (ESG) objectives [47]. ESG has recently been gaining popularity mainly because it is based on the three pillars of ratings and non-financial assessments of a company [48] and is, therefore, an important element in building the business strategy of many companies and firms in different economic areas, including mining. Therefore, the activities analysed are presented in a breakdown of the ESG pillars (environmental, social, governance).

**Table 1.** Actions and initiatives taken by LW Bogdanka S.A. during the pandemic period.

ESG Pillar	Action, Initiative
Governance	establishment of the Crisis Staff
	monitoring the situation and reporting to the Management Board
	development of ongoing recommendations
	implementation of preventive measures
	development of a plan for maintaining the continuity of the mine's operations
	analysis of the financial situation
	establishment of accounting accounts to monitor costs associated with the prevention and control of coronavirus
	developing procedures for dealing with symptoms of coronavirus detected in an employee
	isolation of persons likely to come into contact with the virus
	definition of new rules for cooperation with external companies
Social	obligation to use personal protective equipment against infection
	temperature measurement obligation
	information campaigns
	disinfection of equipment, appliances and workstations
	distribution of disinfectants throughout the plant
	division of crews into smaller groups
	telephone contact indicated, online contact
	suspension of business trips
the introduction of remote working for jobs that do not require on-site presence	

The activities carried out by LW Bogdanka S.A. during this period were focused on two areas: the management area and the social area (Table 1), as the most important thing was to ensure the safety of employees and the continuity of the company's operations. The actions taken in the management pillar were related to the guidelines issued by the Chief Sanitary Inspector and the President of the Higher Mining Authority. A Crisis Staff was set up in the company to, among other things, monitor the situation and report to the Company's Management Board to develop a plan for maintaining the continuity of the mine's operations. In addition, the Staff developed procedures for dealing with symptoms of coronavirus detected in an employee, implemented preventive measures and developed ongoing recommendations. LW Bogdanka S.A. introduced isolation of persons who could come into contact with the virus and defined new rules for cooperation and contact with external companies during the pandemic. In addition, to improve the analysis of the

company's financial situation, it has set up accounting accounts to monitor costs related to the prevention and control of the coronavirus.

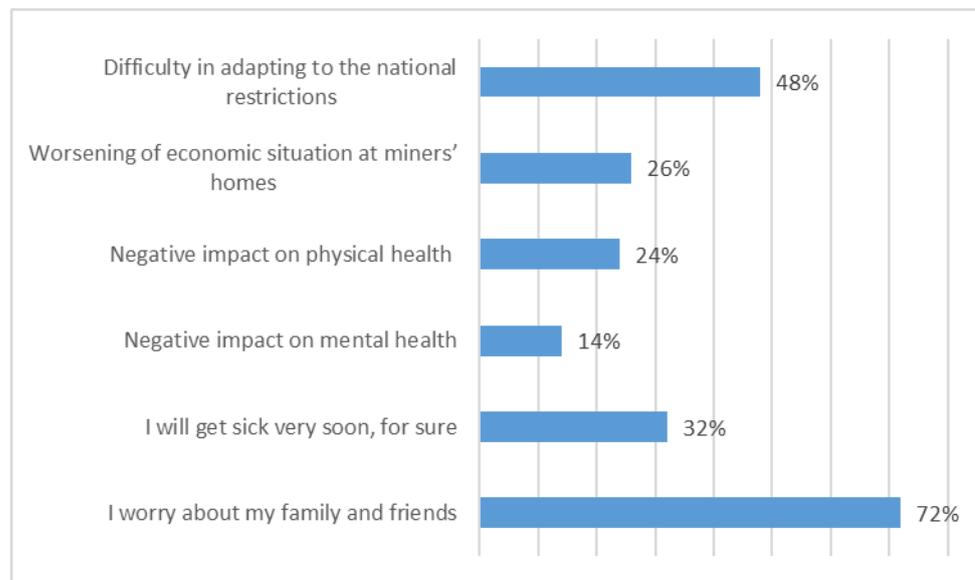
In the social pillar, there were also a number of measures focused on the protection and safety of workers from infection with the new virus. The most important was the obligation for employees to use personal protective equipment against infection. In addition, the company made it mandatory to measure the temperature before entering the mine site, disinfected equipment, facilities and workstations, and distributed disinfectants throughout the site. In accordance with the guidelines, there was a division of crews into smaller groups to minimise the risk of infection mainly due to the contact of employees in common areas (described in Section 4.2). At that time, LW Bogdanka S.A. suspended business trips, introduced remote working for positions that did not require presence at the plant and switched to a form of telephone and online contact. The company also conducted various information campaigns using the necessary internal communication tools.

The initiatives and actions taken by LW Bogdanka S.A. did not include psychological support for employees, the introduction of a helpline on pandemic issues or the possibility of screening employees for the coronavirus, which would certainly have accelerated the identification of infections and the initiation of the necessary steps and procedures.

#### *4.4. Behavioural Response of the Mining Community to the Tightening Measures Introduced*

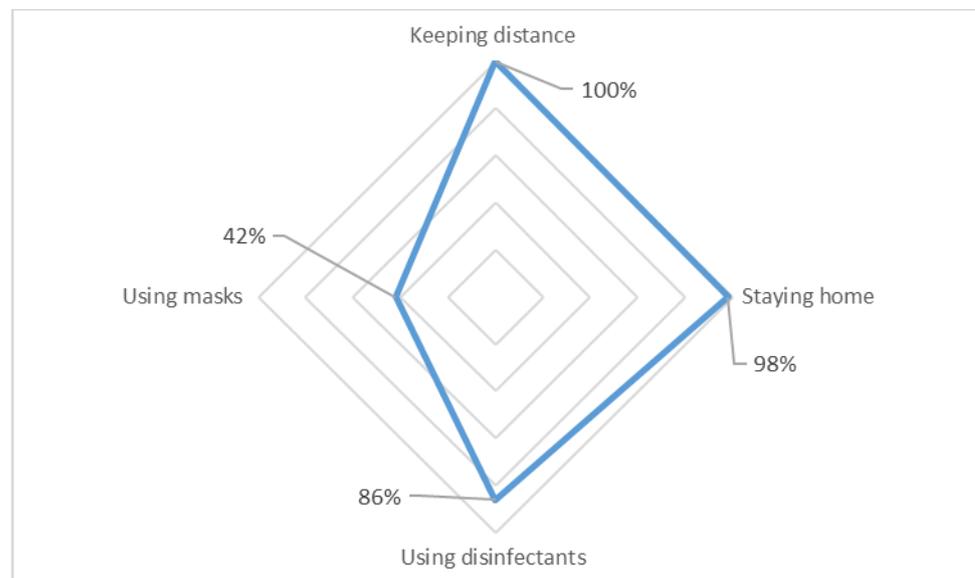
COVID-19 has undeniably affected the behaviour of miners in coal mines. The whole situation related to the rapidly spreading virus, as well as the COVID-19 restrictions introduced by the Coal Companies, has made the whole mining community strongly responsible. This is evidenced, among other things, by the research carried out and presented in [49]. Already in the initial period of the emergence of the threat and after the first restrictions were introduced in the country, as well as the tightening in the mining plants, it could be seen what the adaptation behaviour of the people working in the mines to the situation was like. On the one hand, new obligations were imposed on employees, such as wearing masks, washing hands and using disinfectants, or reducing the number of people using transport, while on the other hand, it was important for miners to adhere to and comply with them. The aforementioned research was carried out based on a checklist among employees working underground in mines undergoing decommissioning. All respondents were concerned about the restrictions and idle time pay introduced due to the COVID-19 hazard, as well as the restrictions due to the miners being barracked at the mine. Selected responses from respondents on what was affected by the pandemic are shown in Figure 8.

“The outbreak of the COVID-19 pandemic clearly showed the importance of social aspects of work organisation and their consequences on the employees' environment” [50]. For all respondents, the pandemic caused significant changes in their lifestyles. All the restrictions introduced in relation to forms of active leisure, the closure of places of public use such as entertainment outlets for families and children, gyms, cinemas or theatres, the cancellation of mass events, and their extension in the form of restrictions on meetings with friends and family during festive periods, i.e., the so-called social isolation, affecting both physical health (24%) and mental health (14%). Such a condition indicates that “Poles are under the influence of the trauma of the pandemic” [51]. Difficulties in adapting to all the restrictions were declared by almost half of the respondents. The miners' psychological burden was all the more intensified because, knowing that there was a high probability of being infected with the virus (32% were convinced that they would become infected soon), they worried about their family and loved ones. Fear of infecting the family was high at 72%. Therefore, 98% of respondents followed the ministry's advice and stayed at home except for necessary matters such as going to work or shopping for food. The economic situation of the miners' families was negatively affected during this period, with 26% stating that the pandemic worsened their economic situation at home due to a much lower total income for all family members, which certainly had an even more negative impact on their mental health.



**Figure 8.** Impact of the pandemic through the eyes of miners. Own study based on [49].

The high percentage of those worried about their families shows how respondents complied with the restriction at the mining plants (Figure 9). All stayed away from others by observing to keep a safe distance. Almost all, 98%, stayed at home, choosing to take an overdue holiday to avoid contact with others and thus reduce the risk of illness. 86% use disinfectants and 42% use face masks.

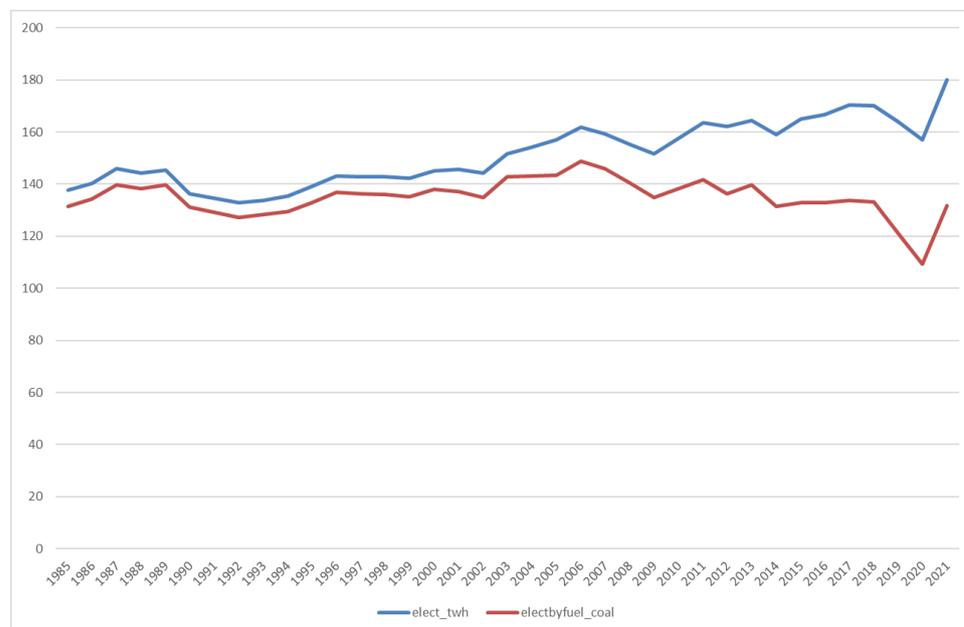


**Figure 9.** General activities to which miners adhered. Own study based on [49].

The described behaviour of the miners shows that the mining community is responsible. Everyone, with a view to the well-being not only of themselves but also of other employees, followed the guidelines, rules or instructions that had been introduced. It can be said that this collective responsibility has mainly contributed to the reduction of infections in mining companies.

#### 4.5. Economic and Social Impact of the COVID-19 Pandemic on Mining Facilities and Miners

The mining industry in Poland is crucial in terms of supplying raw materials for electricity generation. During the COVID-19 pandemic, Poland's energy consumption fell to 157 TWh (and from coal to 109 TWh or about 10% year-on-year), as shown in Figure 10.



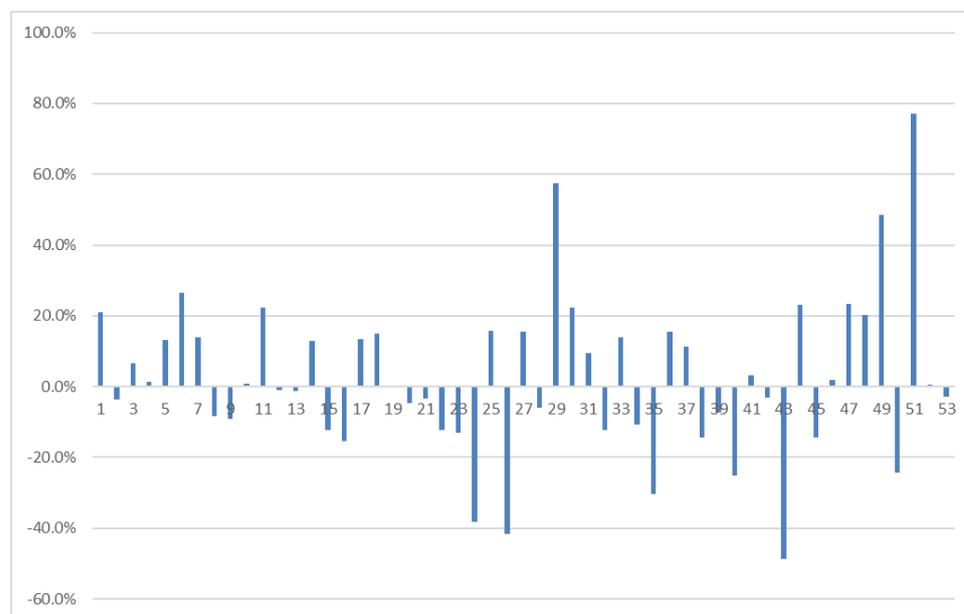
**Figure 10.** Electricity consumption in Poland overall and based on hard coal.

Due to this fact, the demand for coal in this period also decreased—which directly affected the financial results of mining companies. Taking the example of LW Bogdanka S.A., the financial result in 2020 was more than 76% lower than in 2019. The reduction in the level of the financial result directly affected the deterioration of a number of financial indicators (e.g., such as ROA and ROE). This situation was also reflected in the market value of LW Bogdanka S.A.—which is mainly represented by the company's share prices—Figure 11 shows LWB's share prices as the company's appearance on the Warsaw Stock Exchange.



**Figure 11.** LW Bogdanka S.A. share prices.

As the figure shows, share prices have been declining since 2017—nevertheless, 2020 saw the lowest share value since their issue (price per share of PLN 14.17). When considering the dynamics of LWB's share price changes, it should also be noted that the first quarter of 2020 saw the strongest share price decrease since the share issue, i.e., by 48.6% quarter-on-quarter, as shown in Figure 12.



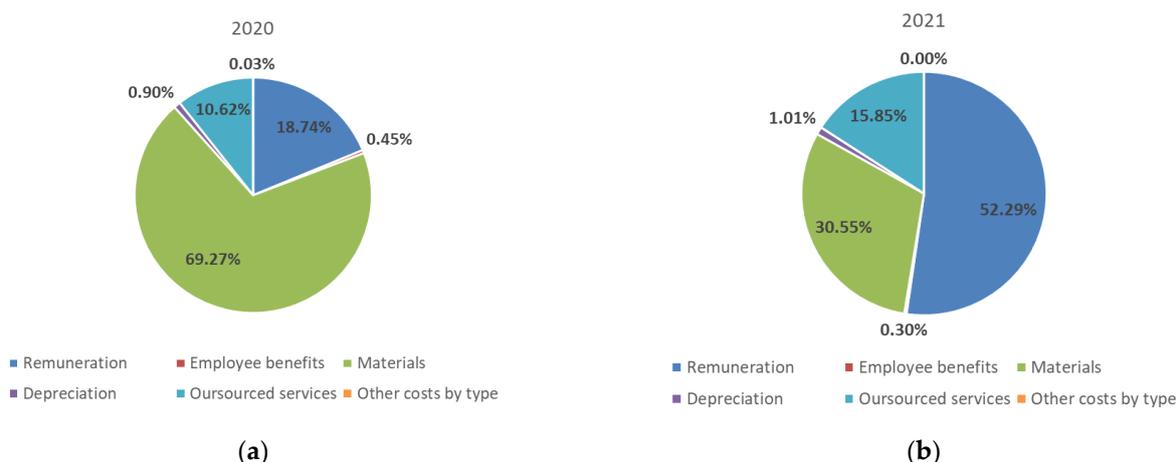
**Figure 12.** Dynamics of changes in the price of LW Bogdanka S.A. shares.

Despite the lower demand for coal for electricity generation, coal mining cannot be stopped overnight (it was assumed that the pandemic situation was a temporary one—and stopping part of the production and then restarting it could cost much more than maintaining constant production), so maintaining adequate coal mining was essential even during the COVID-19 pandemic. Maintaining adequate mining is directly linked to ensuring an adequate number of production workers at the coalfaces—so proper preventive action and speed of detection of infected people was a priority for mining companies during this period. These activities generate certain costs—it was decided here to present, using the example of LW Bogdanka S.A., how these costs evolved in the years of the pandemic period, i.e., 2020 and 2021.

During the period, LW Bogdanka S.A. kept a separate record of costs related to prevention and counteracting the effects of COVID-19 virus infections. The records were kept by type, among others, and included such items as:

- Remuneration;
- Employee benefits;
- Materials;
- Depreciation;
- Outsourced services;
- Other costs by type.

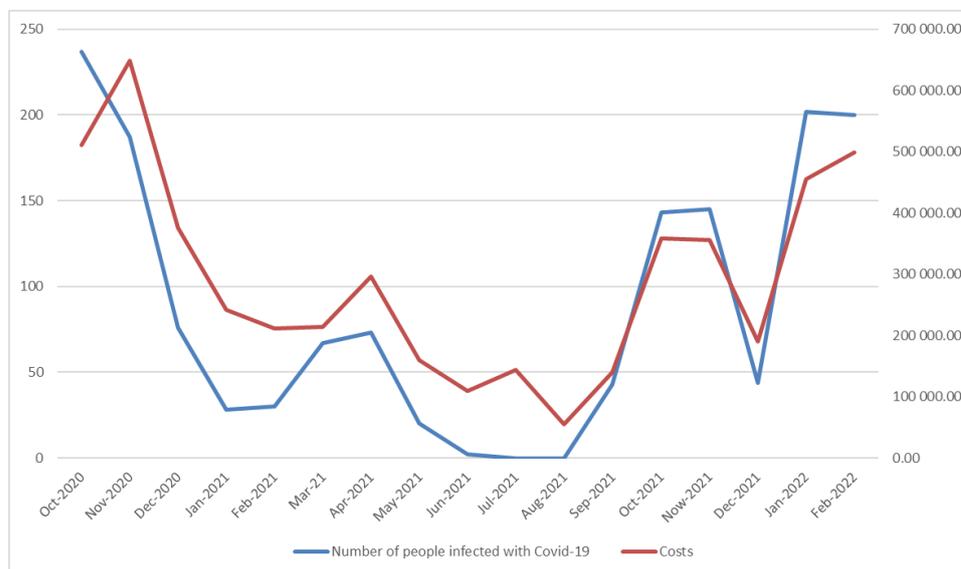
In the context of total costs by type, the costs incurred for COVID-19 were not significant. In 2020, the share of these costs in total costs was around 0.25%, while in 2021, this share fell to 0.12%. Comparing pandemic costs alone year-on-year, it should be noted that in 2021 there was a decrease in these costs of around 50%. The breakdown of generic costs in 2020 and 2021 is shown in Figure 13.



**Figure 13.** Percentage of individual generic costs incurred for the COVID-19 pandemic in 2020 (a) and 2021 (b).

Many factors contributed to the significantly higher costs in 2020, undoubtedly including the surprise of a rapidly spreading pandemic. In 2020, there was a significant increase in the need for all kinds of safety measures to prevent the spread of a pandemic, such as protective masks and disinfectants. Due to the significant increase in demand for these resources and their scarcity, material prices in 2020 were significantly higher than in 2021, where the market met the demand for such products.

The decrease in costs in 2021 is also a result of a lower number of virus infections. LW Bogdanka S.A. responded adequately to the number of infected people, as presented in Figure 14.



**Figure 14.** The number of people infected with COVID-19 and costs incurred for the same period, i.e., October 2020 to February 2022.

As can be seen from the Figure 14 shown, the costs during this period were commensurate with the number of infected people. The correlation coefficient for these variables is 0.92.

**5. Conclusions**

The outbreak of the COVID-19 coronavirus had a huge impact on various areas of activity of mining companies in Poland. As a consequence of the situation, companies were unable to meet their production plan (especially in the initial phase of the pan-

demic). According to data from the Higher Mining Office, hard coal output decreased from 61,623.0 thousand tonnes in 2019 to 54,385.9 thousand tonnes in 2020, a decrease of 7237.1 thousand tonnes. In 2021, the volume of mining was higher than in 2020 and amounted to 55,006.4 thousand t, although this was still a decrease relative to 2019 by 6616.6 thousand t [41,42]. The consequence of the introduction of COVID restrictions in the commercial area was a reduction in the volume of total coal sales, and the difficult staffing situation related to employee absenteeism resulted in the unpreparedness of planned enabling works, which resulted in the failure to implement the face works plan. For the entire period of the pandemic, the companies incurred additional labour costs related to the sickness of employees, remaining in quarantine or reorganising working conditions and carrying out preventive measures such as the introduction of the so-called “standstill” and various information campaigns [52]. However, there were no redundancies due to the worsening situation in the industry, and the dismissals were dictated by the implementation of the decarbonisation strategy and early retirements. The raw material market in Poland is currently in constant transformation (technological, technical, organisational and legal) [8].

Nevertheless, from the research and analysis of the initiatives undertaken and the adaptation measures taken at one of the Polish mining companies, LW Bogdanka S.A., it appears that it has coped with the challenges posed by the pandemic, ensuring the safety of all employees as well as the continuity of the plant’s operations. The procedures and rules of conduct developed over the last two years will certainly constitute mechanisms for responding to a crisis situation, which we hope will not be repeated. The company’s provision of a sense of security to employees (particularly the measures taken to reorganise work, including the division of crews into smaller groups, as well as the provision of personal protective equipment and disinfectants throughout the plant) and the employees’ compliance and adjustment to the procedures introduced by the Boards and Crisis Staff have demonstrated the responsible attitude of the entire mining community of the company. This responsible and balanced approach to the introduced changes in the functioning of LW Bogdanka S.A. during the pandemic ensured that high standards in ESG areas were maintained. The measures taken and the associated increased costs related primarily to ensure the safety of employees and the purchase of necessary materials in the form of, e.g., masks, soaps, and disinfectant fluids had a positive effect in reducing the number of infections among employees.

The topic discussed in the article certainly requires exploration and comparison of initiatives and adaptation activities undertaken by LW Bogdanka S.A. with similar studies from other countries. It will be one of the Authors’ future research directions.

**Author Contributions:** Conceptualisation, B.K. and W.C.; methodology, B.K. and R.R.; validation, B.K., R.R., Ł.H., W.C., O.Ś. and L.D.; investigation, B.K., W.C. and R.R.; resources, Ł.H. and W.C.; data curation, B.K., R.R., L.D. and O.Ś.; writing—original draft preparation, B.K., R.R., Ł.H., W.C., O.Ś. and L.D.; writing—review and editing, B.K., R.R. and Ł.H.; visualisation, B.K., R.R. and Ł.H.; supervision, B.K.; funding acquisition, B.K. 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, scientific subsidy under number: 16.16.100.215.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** Data sharing is not applicable to this article.

**Acknowledgments:** Photos 2–7 and some economic data have been provided by LW Bogdanka S.A.

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

## References

1. Kowal, B.; Wiśniowski, R.; Ogrodnik, R.; Młynarczykowska, A. Selected Elements of a Safe Work Environment in Hard Coal Mines in the Polish Mining Sector. *J. Pol. Miner. Eng. Soc.* **2019**, *2*, 215–223. [[CrossRef](#)]
2. Kustra, A.; Ranosz, R.; Kowal, B. Model of the process of preparing annual technical and economic plans in the public sector. *J. Pol. Miner. Eng. Soc.* **2020**, *21*, 211–215. [[CrossRef](#)]
3. Ranosz, R.; Bluszcz, A.; Kowal, D. Conditions for the innovation activities of energy sector enterprises shown on the example of mining companies. *J. Pol. Miner. Eng. Soc.* **2020**, *21*, 249–256. [[CrossRef](#)]
4. Lubosik, Z.; Jaroszewicz, J. *Zagrożenie Wirusem SARS-CoV-2 w Kopalniach Podziemnych—Wybrane Zagadnienia*; Główny Instytut Górnictwa: Katowice, Poland, 2020. (In Polish)
5. Folwarczny, M. Crisis Management in Mining Companies in the Event of an Epidemic Threat. *J. Pol. Miner. Eng. Soc.* **2020**, *2*, 33–40. [[CrossRef](#)]
6. Sennewald, C.A.; Baillie, C. Crisis management. In *Effective Security Management*, 7th ed.; Butterworth-Heinemann: Oxford, UK, 2020; pp. 199–205. [[CrossRef](#)]
7. Jowitt, S. COVID-19 and the Global Mining Industry. *SEG Discovery* **2020**, *122*, 33–41. [[CrossRef](#)]
8. Sukiennik, M.; Kowal, B. Analysis and Verification of Space for New Businesses in Raw Material Market—A Case Study of Poland. *Energies* **2022**, *15*, 3042. [[CrossRef](#)]
9. Bluszcz, A. European Economies in terms of energy dependence. *Qual. Quant.* **2017**, *51*, 1531–1548. [[CrossRef](#)]
10. Kijewska, A.; Bluszcz, A. Research of varying levels of greenhouse gas emissions in European countries using the k-means method. *Atmos. Pollut. Res.* **2016**, *7*, 935–944. [[CrossRef](#)]
11. Kowal, B.; Domaracká, L.; Tobór-Osadnik, K. Innovative activity of companies in the raw material industry on the example of Poland and Slovakia—Selected aspects. *J. Pol. Miner. Eng. Soc.* **2020**, *2*, 71–77. [[CrossRef](#)]
12. Tobór-Osadnik, K.; Wyganowska, M.; Brejda, A.; Kowal, B. Pro-social Activities within the CSR by the Jastrzębska Spółka Węglowa SA—A Case Study. *J. Pol. Miner. Eng. Soc.* **2020**, *2*, 47–52. [[CrossRef](#)]
13. Bluszcz, A.; Manowska, A. Differentiation of the Level of Sustainable Development of Energy Markets in the European Union Countries. *Energies* **2020**, *13*, 4882. [[CrossRef](#)]
14. Culková, K.; Pavolová, H.; Khouri, S.; ШУТЬКО, Л. Development of the economy of the mineral sector: An example of the countries of the eastern european quarter. *Econ. Innov. Manag.* **2020**, *3*, 77–87. [[CrossRef](#)]
15. European Commission. Available online: [https://ec.europa.eu/clima/policies/strategies/2050\\_en](https://ec.europa.eu/clima/policies/strategies/2050_en) (accessed on 5 May 2022).
16. European Commission. Available online: [https://ec.europa.eu/info/strategy/priorities-2019-2024/europeangreen-deal\\_en](https://ec.europa.eu/info/strategy/priorities-2019-2024/europeangreen-deal_en) (accessed on 5 May 2022).
17. Manowska, A.; Nowrot, A. The importance of heat emission caused by global energy production in terms of climate impact. *Energies* **2019**, *12*, 3069. [[CrossRef](#)]
18. JD. Closure of Mines. Support Will Be Required Up to 36 Thousand Miners. Available online: <https://www.wnp.pl/gornictwo/likwidacja-kopalni-wsparcia-wymagac-bedzie-nawet-36-tys-gornikow,445844.html> (accessed on 10 May 2022).
19. PWC. Energy Industry and COVID-19 (Coronavirus): Strategising for the 'New Normal'. Available online: <https://www.pwc.com/gx/en/issues/crisis-solutions/covid-19/energy-utilities-resources-coronavirus.html> (accessed on 15 May 2022).
20. De Blasis, R.; Petroni, F. Price Leadership and Volatility Linkages between Oil and Renewable Energy Firms during the COVID-19 Pandemic. *Energies* **2021**, *14*, 2608. [[CrossRef](#)]
21. Bąk, P. Good Practices to Counteract Epidemic Emergency in Mining Companies in Poland. *Energies* **2022**, *15*, 5500. [[CrossRef](#)]
22. Gałas, A.; Kot-Niewiadomska, A.; Czerw, H.; Simic, V.; Tost, M.; Wårell, L.; Gałas, S. Impact of COVID-19 on the Mining Sector and Raw Materials Security in Selected European Countries. *Resources* **2021**, *10*, 39. [[CrossRef](#)]
23. Zhong, H.; Tan, Z.; He, Y.; Xie, L.; Kang, C. Implications of COVID-19 for the electricity industry: A comprehensive review. *CSEE J. Power Energy Syst.* **2020**, *6*, 489–495.
24. Siksnyte-Butkiene, I. Impact of the COVID-19 Pandemic to the Sustainability of the Energy Sector. *Sustainability* **2021**, *13*, 12973. [[CrossRef](#)]
25. Gersdorf, T.; Hensley, R.; Hertzke, P.; Schaufuss, P. Electric Mobility after the Crisis: Why an Auto Slowdown Won't Hurt EU Demand. 16 September 2020. Available online: <https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/electric-mobility-after-the-crisis-why-an-auto-slowdown-wont-hurt-ev-demand> (accessed on 12 June 2022).
26. Kumar, A.; Singh, P.; Raizada, P.; Hussain, C.M. Impact of COVID-19 on greenhouse gases emissions: A critical review. *Sci. Total Environ.* **2022**, *806*, 150349. [[CrossRef](#)]
27. Deb, P.; Furceri, D.; Ostry, J.D.; Tawk, N. The economic effects of COVID-19 containment measures. In *Covid Economics Vetted and Real-Time Papers*; International Monetary Fund: Washington, DC, USA, 2020; Volume 24, pp. 32–35.
28. Zheng, B.; Geng, G.; Ciais, P.; Davis, S.J.; Martin, R.V.; Meng, J.; Wu, N.; Chevallier, F.; Broquet, G.; Boersma, F.; et al. Satellite-based estimates of decline and rebound in China's CO<sub>2</sub> emissions during COVID-19 pandemic. *Sci. Adv.* **2020**, *6*, eabd4998. [[CrossRef](#)]
29. Lu, H.F.; Ma, X.; Ma, M.D. Impacts of the COVID-19 pandemic on the energy sector. *J. Zhejiang Univ. Sci. A* **2021**, *22*, 941–956. [[CrossRef](#)]
30. Chen, S.T.; Kuo, H.I.; Chen, C.C. The relationship between GDP and electricity consumption in 10 Asian countries. *Energy Policy* **2007**, *35*, 2611–2621. [[CrossRef](#)]

31. Chen, S.; Igan, D.; Pierri, N.; Presbitero, A. *Tracking the Economic Impact of COVID-19 and Mitigation Policies in Europe and the United States*; IMF Working Paper; International Monetary Fund: Washington, DC, USA, 2020. Available online: <https://www.elibrary.imf.org/view/journals/001/2020/125/001.2020.issue-125-en.xml> (accessed on 7 July 2022).
32. Fezzi, C.; Fanghella, V. Real-Time Estimation of the Short-Run Impact of COVID-19 on Economic Activity Using Electricity Market Data. *Environ. Resour. Econ.* **2020**, *76*, 885–900. [[CrossRef](#)] [[PubMed](#)]
33. Memmott, T.; Carley, S.; Graff, M.; Konisky, D.M. Sociodemographic disparities in energy insecurity among low-income households before and during the COVID-19 pandemic. *Nat. Energy* **2021**, *6*, 186–193. [[CrossRef](#)]
34. Nagaj, R.; Korpysa, J. Impact of COVID-19 on the Level of Energy Poverty in Poland. *Energies* **2020**, *13*, 4977. [[CrossRef](#)]
35. Biernat-Jarka, A.; Trębska, P.; Jarka, S. The Role of Renewable Energy Sources in Alleviating Energy Poverty in Households in Poland. *Energies* **2021**, *14*, 2957. [[CrossRef](#)]
36. Siksnyte-Butkiene, I. Combating Energy Poverty in the Face of the COVID-19 Pandemic and the Global Economic Uncertainty. *Energies* **2022**, *15*, 3649. [[CrossRef](#)]
37. Clark, I.K.H.; Chun, S.; O'Sullivan, K.C.; Pierse, N. Energy Poverty among Tertiary Students in Aotearoa New Zealand. *Energies* **2022**, *15*, 76. [[CrossRef](#)]
38. Mamica, L.; Glowacki, J.; Makiela, K. Determinants of the Energy Poverty of Polish Students during the COVID-19 Pandemic. *Energies* **2021**, *14*, 3233. [[CrossRef](#)]
39. Strojny, J.A.; Chwastek, M.S.; Badach, E.; Lisek, S.J.; Kacorzyc, P. Impacts of COVID-19 on Energy Expenditures of Local Self-Government Units in Poland. *Energies* **2022**, *15*, 1583. [[CrossRef](#)]
40. Pilipczuk, O. Determinants of Managerial Competences Transformation in the Polish Energy Industry. *Energies* **2021**, *14*, 6788. [[CrossRef](#)]
41. Report. *Assessment of Work Safety, Assessment of Occupational Safety, Mine Rescue and General Safety in Connection with Mining and Geological Activities in 2021*; Wyższy Urząd Górniczy: Katowice, Poland, 2022. (In Polish)
42. Raport. *Assessment of Work Safety, Mine Rescue and General Safety in Connection with Mining and Geological Activities in 2020*; Wyższy Urząd Górniczy: Katowice, Poland, 2021. (In Polish)
43. Kowal, B.; Świniarska, O. *Overview of Safety Initiatives Taken by Mining Companies during the Pandemic by ESG Pillars*; Wydawnictwo Politechniki Śląskiej w Gliwicach: Gliwice, Poland, chapter in the monograph; unpublished. (In Polish)
44. Sasin, J. *Guidelines of the Minister of State Assets and the Chief Sanitary Inspector for the Functioning of the Mine during the SARS-CoV-2 Epidemic*; Minister Aktywów Państwowych: Warszawa, Poland, 2020. (In Polish)
45. Bąk, P.; Kapusta, M.; Sukiennik, M. Mining company management in case of the epidemic emergency. *J. Pol. Miner. Eng. Soc.* **2020**, *2*, 231–235. [[CrossRef](#)]
46. Regulation of the Council of Ministers of 6 May 2021 on Establishing Certain Restrictions, Orders and Bans in Connection with an Epidemic, Warszawa 2021. Available online: <https://dziennikustaw.gov.pl/D2021000086101.pdf> (accessed on 26 April 2022). (In Polish)
47. Kasiarz, M. Sustainable Development as a New Requirement of Corporate Strategies. Available online: [https://www.ey.com/pl\\_pl/biuletyn-ryzyka/zrownowazony-rozwoj-jako-nowy-wymog-strategii-przedsiębiorstw](https://www.ey.com/pl_pl/biuletyn-ryzyka/zrownowazony-rozwoj-jako-nowy-wymog-strategii-przedsiębiorstw) (accessed on 28 April 2022). (In Polish)
48. Fidos, A. What Has the Last 12 Months Brought to the CSR Area? Available online: <https://www.proto.pl/aktualnosci/csr-ewoluuje-w-esg-co-zmienilo-sie-w-2021-roku-w-obszarze-spoecznej-odpowiedzialnosci> (accessed on 2 May 2022). (In Polish).
49. Lubosz, A. The Impact of COVID-19 on the Behavior of Miners in a Selected Coal Mine Support Systems in Production Engineering, Energy and Mining—Prospects for Sustainable Development. *Sci. J. Syst. Wspomagania* **2020**, *10*. Available online: <http://www.stegroup.pl/attachments/category/71/10.pdf> (accessed on 2 June 2022). (In Polish)
50. Kamińska-Berezowska, S.; Suchacka, M. Safety and Work Organization Management in the Early Days of the COVID-19 Pandemic in the Lignite Mining and Energy Sector in Poland. *Energies* **2022**, *15*, 4239. [[CrossRef](#)]
51. Długosz, P. Social Effects of the COVID-19 Pandemic among Poles. Available online: [https://ifis.up.krakow.pl/wp-content/uploads/sites/9/2020/10/Spo%C5%82eczne-skutki-pandemii-w-%C5%9Br%C3%B3d-Polak%C3%B3w\\_raport1.pdf](https://ifis.up.krakow.pl/wp-content/uploads/sites/9/2020/10/Spo%C5%82eczne-skutki-pandemii-w-%C5%9Br%C3%B3d-Polak%C3%B3w_raport1.pdf) (accessed on 24 May 2022). (In Polish)
52. Available online: <https://www.jsw.pl/biuro-pra-sowe/aktualnosci/archiwum/artykul-archiwalny/informacja-jsw> (accessed on 28 July 2022). (In Polish)