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The past, present and future of Konin Lignite Mine in central Poland

Zbigniew Kasztelewicz[1]*, Dagmara Frydrychowicz[2], Ewa Galantkiewicz[3], Marek Widera[4]

[1] Mining Engineering & Occupational Safety, AGH University of Science and Technology, Mickiewicza 30, 30-059 Kraków, Poland
[2] District Museum in Konin, Muzealna 6, 62-505 Konin, Poland
[3] PAK KWB Konin S.A., 600-lecia 9, 62-540 Kleczew, Poland
[4] Institute of Geology, Adam Mickiewicz University, Krygowskiego 12, 61-680 Poznań, Poland
* corresponding author, e-mail: kasztel@agh.edu.pl

Abstract

The Konin region is widely considered to be the cradle of lignite mining in Poland, having probably exploited as early as the 12th century on the outskirts of the present-day town of Konin. However, not until the first half of the 20th century were lignite-rich deposits discovered. In turn, industrial lignite mining in this region was initiated by the Germans during the Second World War and has been continued by Polish crews since 1945. Thus, 80 years of Polish history of Konin Lignite Mine (KLM) will be celebrated in 2025. Over eight decades, KLM has launched several opencasts, only one of which remains at the start of 2025. During this time, hundreds of millions of tonnes of lignite (646.1 million tonnes) have been mined. In order to extract such large quantities of lignite, billions of cubic metres of water (6.14 billion m^3) and overburden (3.59 billion m^3) had to be pumped out and removed, respectively. In this way, the natural environment in the vicinity of Konin was strongly transformed geologically, hydrogeologically and geomorphologically. The results of these changes include numerous anthropogenic hills (external dumps) and water reservoirs (mining lakes). They, along with other post-mining areas, have been subject to reclamation since at least the 1970s. KLM is carrying out reclamation works in the following directions: water, forest, agricultural, recreational, etc. It is currently expected that lignite mining in the Konin region will most likely end in 2026–2027.

Key words: lignite exploration, deposit dewatering, overburden removal, lignite exploitation, surface reclamation, Konin region

1. Introduction

The Konin region plays a very important role in lignite mining in Poland. Mining has occurred in this region for centuries, but extraction for local and small needs began only in the 19th century. In the following century, during the Second World War, the Germans began to explore deposits and exploit lignite on an industrial scale to the north of Konin. In 1945, the Polish history of lignite mining in this area began. Thus, this year (2025) marks the 80th anniversary of Konin Lignite Mine (KLM).

This KLM anniversary constitutes a good opportunity to document its history, not only to Polish, but also to international communities. First, the identification and occurrence of lignite deposits in the vicinity of Konin will be described, but lignite mining in this area, i.e. the 12 opencasts that have existed here over the last 80 years (Fig. 1), will receive most attention. Lignite exploitation would not have been possible without the dewatering of its deposits and the removal of huge amounts of overburden. Of course, post-mining areas must be reclaimed,

which KLM has been doing with great success for over half a century.

Coal/lignite mining generally reflects the socio-political situation influencing economic processes in Poland well. Therefore, the present paper distinguishes three historically conditioned stages of lignite mining development in the Konin region: the Second World War and earlier, communist-regime times and democratic times. These time periods correspond to significantly different political systems, which also had different market rules.

The main aim of the current paper is to present the most important events in the history of KLM. This will be achieved by providing the following: 1) the opening and closing dates of subsequent lignite opencast mines; 2) the volume of extracted lignite, pumped out water and overburden removed; 3) the basic mining parameters of lignite seams exploited; 4) the implemented directions of post-mining land reclamation; and 5) the current status and future prospects for KLM.

2. Geological and geomorphological sketch

For the purposes of the present study, the most important features are lignite seams exploited by KLM. It so happens that only the two youngest main lignite seams found in the Polish Lowlands were mined, i.e. the second Lusatian lignite seam (LLS-2) and the first Mid-Polish lignite seam (MPLS-1). They are of Early-Middle Miocene and Middle Miocene age, respectively (Piwocki & Ziembińska-Tworzydło, 1997; Widera, 2007).

The LLS-2 was exploited only in the Lubstów opencast in the years 1982–2009. Its maximum thickness was 86.2 m, making it the thickest in the Konin Basin and the third thickest in Poland. The quality of the LLS-2 for electricity production was also good, i.e. the calorific value (Q_i^r) was 10.1 MJ/kg, the ash yield (A^d) 15 wt% and the sulphur content (S_t^d) 0.8 wt%. In contrast, the MPLS-1 has been mined in the remaining 11 opencasts throughout the entire 80-year history of KLM. Its maximum thickness amounted to 19.8 m in the area of the Pąt-

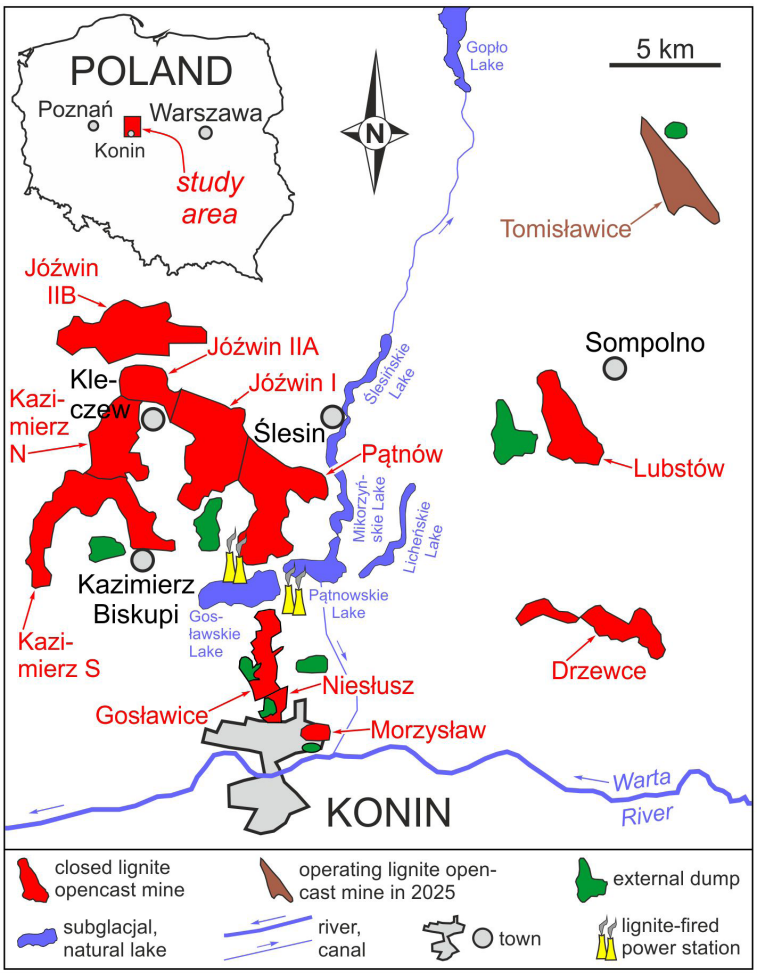

Fig. 1. Location map of opencasts operating in the 80-year history of Konin Lignite Mine (KLM).

nów opencast (see Fig. 1). However, its chemical and technological parameters differ between opencasts. For example, the Jóźwin IIA and Tomisławice opencasts fall within the following ranges: calorific value (Q_i^r) – 9.0–9.1 MJ/kg, ash yield (A^d) – 22.8–23.4 wt% and sulphur content (S_t^d) – 1.0–2.1 wt% (Widera, 2021, 2022).

From a geomorphological point of view, all lignite opencasts belonging to KLM are located in the hinterland of the Last Glacial Maximum. Thus, the surface deposits are mainly of Weichselian age, and a locally relatively thin layer of Holocene strata is also present. The study area is characterised by the occurrence of numerous glaciogenic hills and subglacial channel lakes, whose relative heights and depths reach up to several dozen metres (Frydrychowicz et al., 2024). This is important within the context of the creation of many external dumps and post-mining water reservoirs by KLM (see Fig. 1).

3. Material and methods

The information presented here is the result of investigations on the development of lignite mining in the vicinity of Konin. The mine data were provided by KLM. The black and white photographs below come from the archives of the District Museum in Konin (DMK), while the colour photographs were taken by the present authors.

The research methodology used first included familiarisation with extensive material contained in the literature and local and national press, and also material on the Internet. Then, the necessary numerical data were collected regarding mining operations (exploited lignite, water pumped out, removed overburden, etc.) conducted in the years 1945–2024. After selecting the vast source material, some data regarding lignite mining in the Konin region were included in the text. Other information is presented in tabular form. In turn, the photographs in the present paper show just some of the interesting objects and events from the 80-year history of KLM. Other supplementary data, and especially photographs regarding lignite mining in the study area, can be found in the paper by Frydrychowicz et al. (2024).

4. Results

4.1. History of KLM

4.1.1. Second World War and earlier

Natural exposures of lignite in the vicinity of present-day Konin, as in other parts of the European Lowlands, were already known to ancient tribes. This goes mainly for areas where lignite seams were first raised relatively high (tectonically or glaciotectonically) and then cut by river waters. This is the situation in the valley of the River Warta, which flows through the town of Konin (Fig. 1).

The year 1151 is considered to reflect the start of lignite mining in Polish lands, as demonstrated indirectly in an inscription on the Konin Pillar (e.g., Ciuk, 1994; Kasztelewicz, 2004; Widera, 2021, 2022; Wachocki et al., 2025). It is the most famous symbol of Konin, but also the oldest road sign (milepost) in Europe, beyond the borders of the former Roman Empire. It is made of quartzite sandstone, which was mined in the village of Brzeźno, located on the current eastern outskirts of Konin. Simply put, in order to exploit the sandstone, it was necessary to remove the overburden, including the lignite bed lying directly on it (Skoczylas, 1994; Kowalczykiewicz, 1995; Wachocki et al., 2025).

Over the following centuries, lignite lost to wood from the surrounding forests. In the Konin region, interest in lignite did not become apparent until the second half of the 19th century and the beginning of the 20th century. At that time, it was mined periodically and in small quantities for the needs of the local population. It is worth mentioning here that in 1934, near Morzysław (currently a district of Konin), the roof of a lignite seam was uncovered. This happened accidentally during the exploitation of clay (i.e. the Neogene so-called Poznań Clays) for the needs of the local brickyard (Kowalczykiewicz, 1995; Frydrychowicz et al., 2024).

In the study area (Fig. 1), the breakthrough in lignite mining occurred during the Second World War. At that time, the Germans explored the Konin region in search of lignite and started its exploitation on an industrial scale. In October 1942, the first tonnes of lignite were mined in the Morzysław opencast. During the war years, the later deposits of Niesłusz and Gosławice (Niesłusz and Gosławice opencasts) and the preliminary deposits located north of Lake Gosławskie (Pątnów, Kazimierz and Jóźwin opencasts) were documented. In 1942, the Germans also began building a briquette factory in Marantów – located 1.5–2 km north-west of the Morzysław opencast. This was connected to their plans to build a large mining, energy and chemical plant. On January 15, 1945, the Germans left Konin, running from the approaching Soviet troops (Table 1).

4.1.2. Communist-regime times

In the years 1945–1989, Poland was under the political domination of the Soviet Union. At that

Table 1. The most important dates in the history of lignite mining in the Konin region.

Second World War and earlier	
year	event
1151	beginning of lignite mining in Polish lands – inscription on the oldest Polish road sign in Konin
1934	discovery of a lignite roof (during the extraction of clay for brick production) in Glinka near Morzysław; no lignite mining
1942	extraction of the first tonnes of lignite from the Morzysław opencast managed by the Germans; they start building a briquette factory in Marantów, located about 1.6 km from the Morzysław opencast
Communist-regime times	
year	event
1945	the Germans leave Konin (January); the Soviet Army occupy Konin (January); the Morzysław opencast and the briquette factory in Marantów are taken over by the Poles (February); the beginning of the Polish history of lignite mining in Konin under the official name of the Lignite Mine and Briquette Factory Morzysław–Marantów; resumption of lignite mining (October) in the Morzysław opencast by Polish crew
1946	launch of the briquette factory in Marantów
1953	termination of lignite exploitation in the Morzysław opencast and commencement of lignite exploitation in the Niesłusz opencast
1955	change of the official mine name to the Konin Lignite Mine, abbreviated as the KLM
1957	commencement of lignite exploitation in the Gosławice opencast
1958	launch of the Konin Power Plant
1961	termination of lignite exploitation in the Niesłusz opencast
1962	commencement of lignite exploitation in the Pątnów opencast
1965	commencement of lignite exploitation in the Kazimierz S opencast
1967–1969	launch of the Pątnów Power Plant
1971	commencement of lignite exploitation in the Jóźwin opencast; first in the Jóźwin I opencast and then in the Jóźwin IIA opencast
1974	termination of lignite exploitation in the Gosławice opencast
1982	commencement of lignite exploitation in the Lubstów opencast; opening the District Museum in Konin (i.e. in Konin-Gosławice)
Democratic times	
year	event
1995	commencement of lignite exploitation in the Kazimierz N opencast
1997	termination of lignite exploitation in the Kazimierz S opencast
1999	change of the mine name to the Sole Shareholder Company of the State Treasury, Konin Lignite Mine in Kleczew Inc.
2002	termination of briquette production in Marantów
2003	termination of lignite exploitation in the Jóźwin (I & IIA) opencast and commencement of lignite exploitation in the Jóźwin IIB opencast
2006	commencement of lignite exploitation in the Drzewce opencast
2009	termination of lignite exploitation in the Lubstów opencast
2011	termination of lignite exploitation in the Kazimierz N opencast and commencement of lignite exploitation in the Tomisławice opencast
2012	change of the official mine name to the Pątnów–Adamów–Konin, Konin Lignite Mine Inc.
2022	termination of lignite exploitation in the Drzewce opencast
2023	termination of lignite exploitation in the Jóźwin IIB opencast
2025	80th anniversary of the Konin Lignite Mine (February); lignite is mined exclusively in the Tomisławice opencast

time, the economic system was closely linked to the communist regime in power. The Polish economy was characterised by its subordination to political goals. This was achieved through the central management of all economic processes in the country.

A Polish crew took over the lignite opencast in Morzysław and the briquette factory in Marantów from Soviet troops on February 2, 1945. Since that day, the Polish history of lignite mining in the Konin region has continued. Late in 1945, mining was resumed, and by the end of that year,

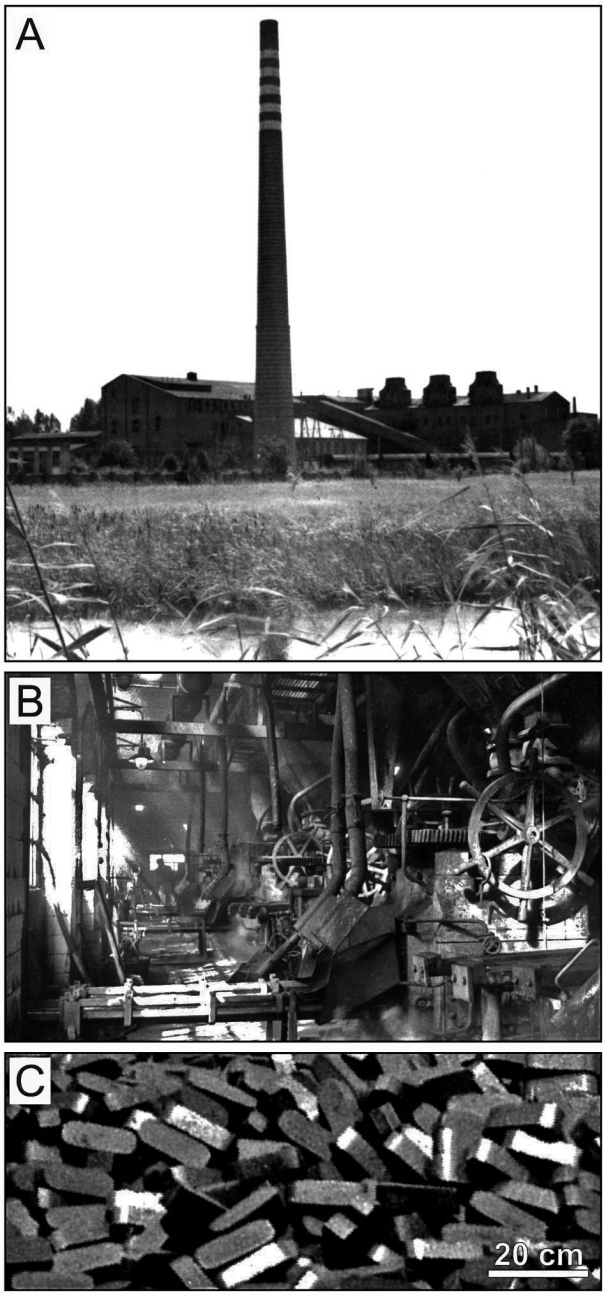

Fig. 2. Briquette factory in Marantów. **A –** View to the east from the area of the future Gosławice opencast; **B –** View of the briquette press hall; **C –** Close-up view of briquettes (photographs from archives of the District Museum in Konin, DMK).

>10,000 tonnes of lignite had been extracted from the Morzysław opencast. The briquette factory in Marantów was put into operation only in the second half of 1946 (Fig. 2). This was due to the fact that most of the devices came from a closed briquette factory in Klettwitz (south-eastern Germany, Lower Lusatia region), and the Polish crew had no experience in operating them. It should be

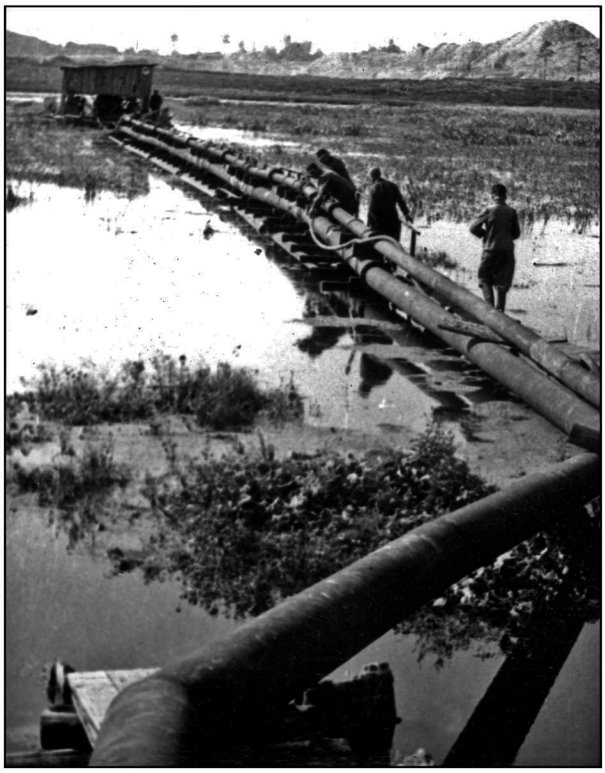

Fig. 3. Drying of the ground surface in the area of the future Niesłusz opencast (photograph from DMK archives).

added that, for political reasons, the German offer of getting the briquette factory launched quickly was rejected (Kowalczykiewicz, 1995, 1996; Kasztelewicz, 2004).

At the turn of the 1950s and 1960s, there was a shortage of lignite for the briquette factory and local customers. Simply put, lignite reserves in Morzysław were small, so in 1949, the construction of the Niesłusz opencast began, which was planned to be completed very rapidly. Unfortunately, unfavourable hydrological, geological and weather conditions caused a delay of several years. It was necessary to dry the area of the future Niesłusz opencast (Fig. 3). The greatest problem, not resolved for a long time, was the removal of >0.5 million m^3 of liquefied lacustrine muds (Kowalczykiewicz, 1995; Galantkiewicz, 2010; Fagiewicz, 2016). For the above reasons, lignite extraction from this small opencast did not start until after four years of preparations, i.e. in 1953 (Table 1).

The above-mentioned valuable experience gained in Niesłusz resulted in the fact that when subsequent opencasts were opened, dewatering and overburden removal process were less time consuming. Until the end of the communist times in 1989, KLM opened and closed successive open-

casts, and lignite production generally increased, although in waves, to ~15 million tonnes in 1987 (Fig. 4). The sharp increase in lignite production was related to the launch of the Konin Power Plant in 1958 and the Pątnów Power Plant in 1967–1969 (Table 1). However, a significant decline in mining at the turn of the 1970–80s was related to the depletion of lignite in the opencasts operating at that time. The trends in overburden removal were similar, although on a scale several times larger. For example, >100 million m^3 of overburden was removed in 1984, this being the largest amount in the entire history of KLM (Fig. 5).

The period discussed (1945–1989) was characterised by a centrally planned economy. The priority for the government was the development of Poland based on heavy industry, including coal mining, both hard coal and lignite. During these years, over 95 per cent of Polish electricity was produced from coal, of which up to 35 per cent was from lignite (e.g., Kasztelewicz, 2007; Widera et al., 2016; Kaliński, 2017; Widera, 2021). Hence, the most high-ranking representatives of government authorities willingly participated, for example, in the opening and closing of the Konin lignite opencasts (Fig. 6A, B). These events were celebrated very solemnly and, above all, were permeated with communist ideology, such as 'For the People's Republic of Poland, the builders of the Pątnów opencast' (Fig. 6C).

The achievements mentioned above, mainly in lignite mining and overburden removal, were possible thanks to technological progress. In the first years after the Second World War, part of the overburden and lignite was mined by single-bucket excavators (Fig. 7A). They were gradually replaced by multi-bucket chain and wheel excavators (Fig. 7B). Both lignite and overburden were transported by the mine railway, which caused frequent track failures, especially on external and internal dumps (Fig. 7C). The greatest transport revolution took

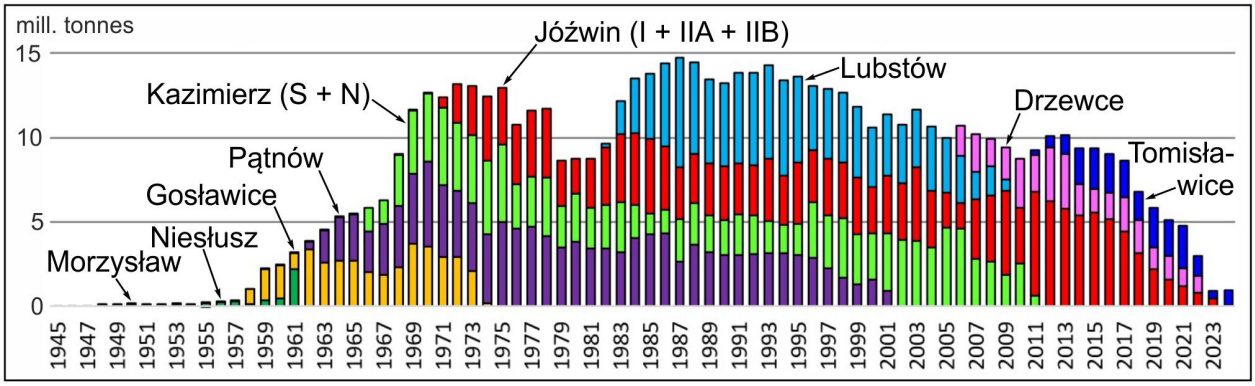

Fig. 4. Lignite mining in the Konin Lignite Mine (KLM) in the years 1945–2024 (based on mining data). Note the years and volume of lignite exploitation in individual opencasts.

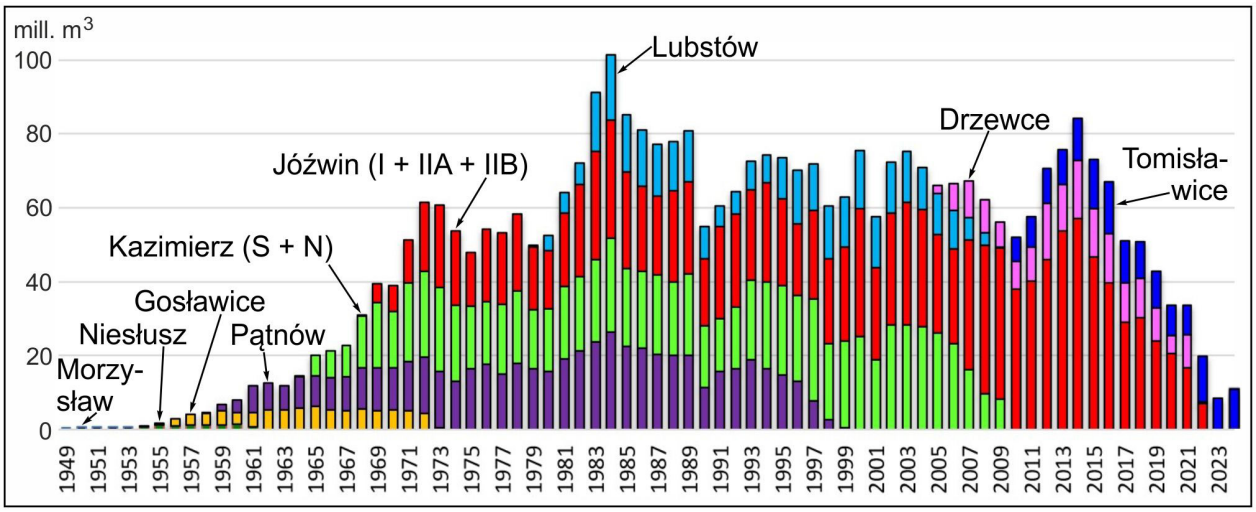

Fig. 5. Overburden removal in the Konin Lignite Mine (KLM) in the years 1945–2024 (based on mining data). Note the years and volume of overburden removal in individual opencasts.

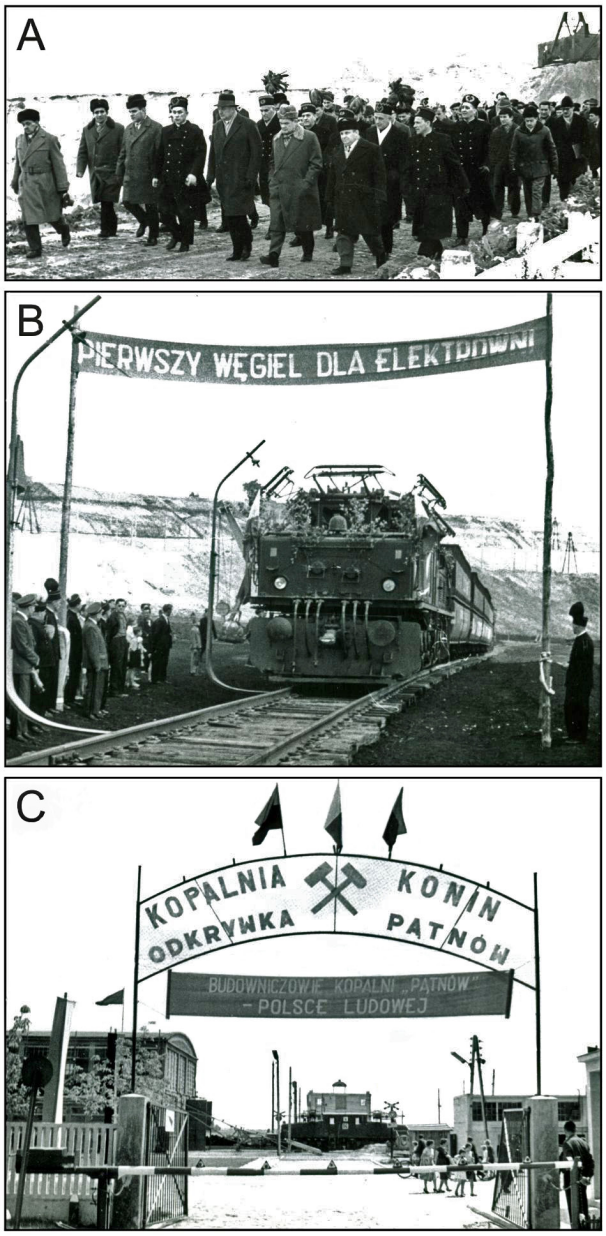

Fig. 6. Important events in the Konin Lignite Mine (KLM) during communist times. **A –** Inspection of the Kazimierz S opencast mine by government representatives with Prime Minister P. Jaroszewicz (the tallest person in the first row (centre), wearing a hat); **B**, **C –** Ceremonial commencement of lignite mining in the Pątnów opencast; note the slogans: 'First coal for power plant' in Figure 6B and 'For the People's Republic of Poland, the builders of the Pątnów opencast' in Figure 6C (photographs from DMK archives).

place at the Kazimierz S opencast in 1965, where belt conveyors were used for the first time in KLM and in the Polish lignite mining industry. Since then, all overburden has been transported by belt conveyors, while lignite has been transported to the ground surface by belt conveyors and then to Konin and Pątnów power plants by mine railway (Fig. 7D–F).

Mining works would not have been possible without drying the overburden and lignite seams, i.e. the LLS-2 and MPLS-1. For over half a century (i.e. from 1945 in the area of the Morzysław opencast to 1996 in the area of the Pątnów opencast), an underground dewatering system operated in KLM. The miners responsible for underground dewatering were jokingly called 'seamen from Pątnów' (Fig. 8A; Galantkiewicz, 2010). The water flowed by gravity to the vicinity of the pump station, which pumped it into surface channels (Fig. 8B) and, after partial purification, into nearby rivers. In the years 1945–1996, ~390 km of dewatering tunnels were built at the floor of exploited lignite seams. Gradually, however, well dewatering was introduced, and since 1996 it has been used exclusively in the Konin opencasts (Kasztelewicz, 2004).

4.1.3. Democratic times

On June 4, 1989, the first partially free parliamentary elections after the Second World War were held in Poland. Opposition representatives were allowed to run in these elections. The elections were held thanks to an agreement between the communist authorities and the democratic opposition centred around Lech Wałęsa – the legendary leader of the 10-million-member 'Solidarność' (i.e. 'Solidarity') trade union. Then, a political transformation and economic changes began. The centrally planned economy was gradually replaced by the free market.

Starting in 1989, in the changing political and economic situation, all KLM activities were no longer financed from the state budget, but from the mine's own funds. On July 1, 1999, KLM, as a state-owned enterprise, was transformed into a sole-shareholder company of the State Treasury. In the years 1989–2025, lignite exploitation was commenced in four and completed in seven opencasts. Currently (early 2025), mining occurs exclusively at the Tomisławice opencast (see Fig. 1; Table 1), for which the entire concession process was carried out after Poland's accession to the European Union in 2004 (Widera, 2022).

In general, in the years 1989–2024, lignite production in KLM shows a very clear downward trend. In the 1980s and 1990s, 12–15 million tonnes of lignite were mined annually, while in the years 2023–2024, this was <1 million tonnes *per annum* (see Fig. 4). Nevertheless, the annual demand for lignite in the Pątnów Power Plant (the Konin Power Plant is currently fired only with wood biomass) reaches ~1.9–2.5 million tonnes. More than half of

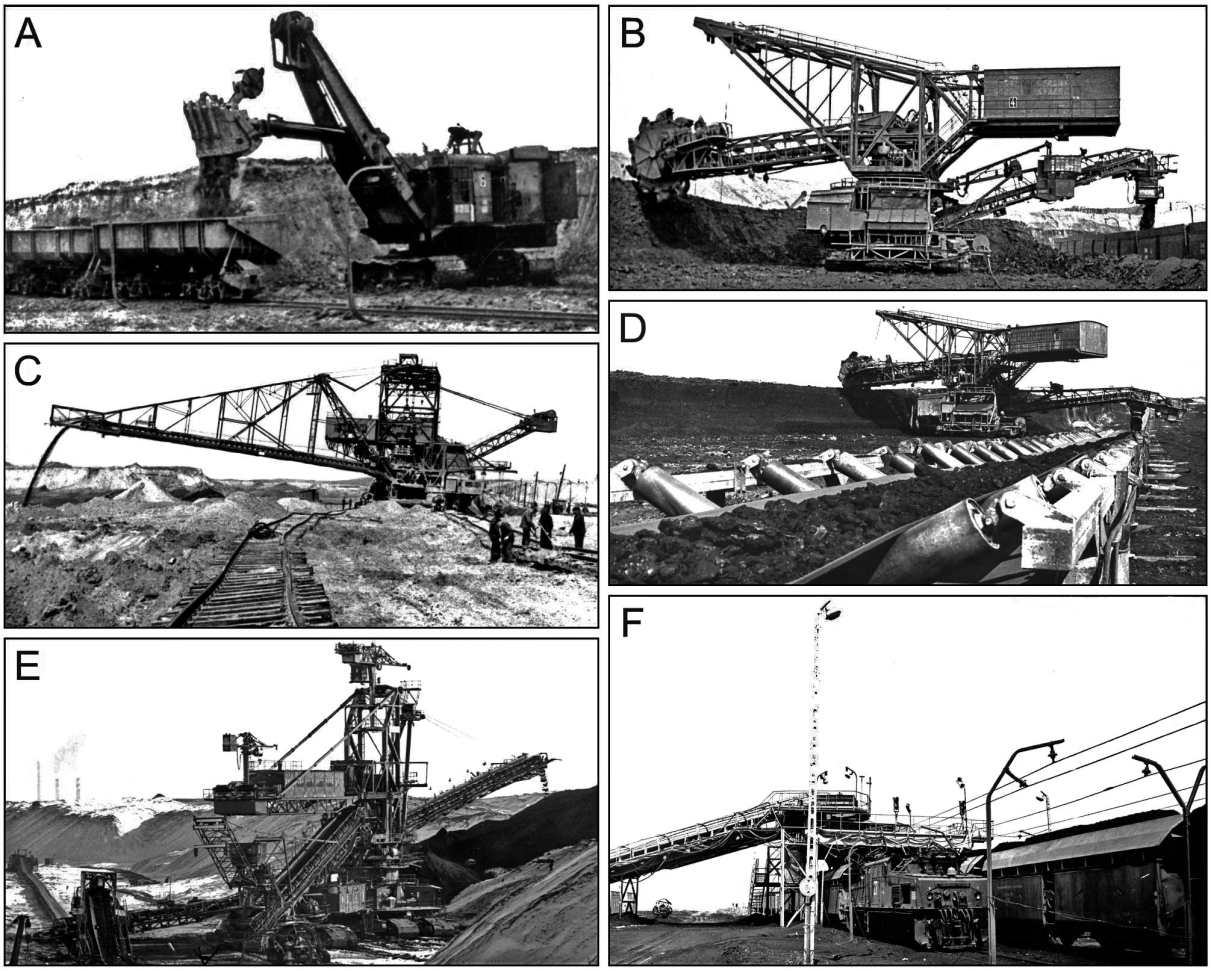

Fig. 7. Technological progress in the Konin Lignite Mine (KLM) during communist times. **A–C –** From single- to multi-bucket excavators and railway transport; **D–F –** Predominance of lignite and overburden transport by belt conveyors; note that on the ground surface only lignite is transported by mine railway in Figure 7F (photographs from DMK archives).

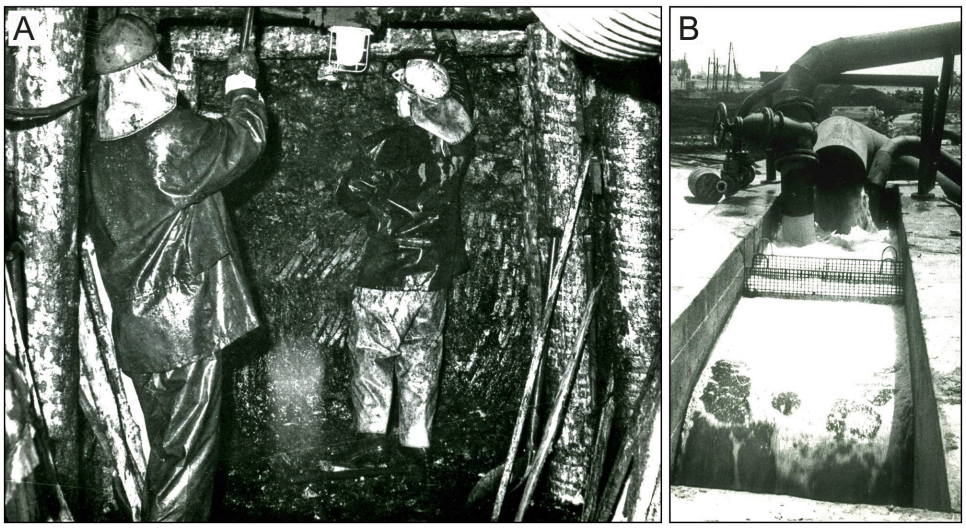

Fig. 8. Underground dewatering system used in the Konin Lignite Mine (KLM) in 1945–1996. **A –** 'Seamen from Pątnów'; **B –** Water from underground dewatering drained into surface channels and rivers (photographs from DMK archives).

this (~1.0–2.0 million tonnes) came from the nearby Jóźwin IIB and Tomisławice opencasts in 2022–2023, while the rest (~0.5–0.9 million tonnes) was imported from the Sieniawa Lignite Mine, which is over 230 km away (Frydrychowicz et al., 2024; Widera et al., 2024a, b). Despite this, in 2024, lignite supplies to the Pątnów Power Plant from Sieniawa (1.01 million tonnes) were greater than those from KLM, i.e. from the Tomisławice opencast (0.94 million tonnes).

4.2. Current status of KLM

In the first half of 2025, lignite is mined only in the Tomisławice opencast. It is one of the smaller opencasts in KLM history, where the exploitation fronts (lignite walls) are 300–600 m long (Fig. 9). The 40–70-m-thick overburden is composed of glaciogenic sediments, i.e. glacial tills, fluvioglacial sands and gravels, and lacustrine-glacial muds (Wachocki et al., 2024). These muds are a particularly great problem for KLM, as their dewatering is very difficult.

The first Mid-Polish lignite seam (MPLS-1) is exclusively mined in the Tomisławice opencast. Its thickness amounts to a maximum of 11.8 m, with an average of 6.9 m. Unfortunately, within this seam (MPLS-1), there are numerous mineral interbeds in the form of lenses of crevasse-splay sands up to >4 m thick (e.g., Dziamara et al., 2023; Wachocki et al., 2024), as well as a layer of lacustrine clays with a maximum thickness of 0.8 m (e.g. Chomiak et al., 2020; Widera, 2021). In addition, a 'lignite-free' zone (up to 500 m long and 150 m wide) appeared suddenly in the Tomisławice opencast in 2022. The origin of this zone has not yet been fully explained, but about 0.9 million tonnes of lignite have been lost (Widera et al., 2024c). Due to these difficulties, according to mine data, only 0.94 million tonnes of lignite were mined in the Tomisławice opencast in 2024.

As presented above, the amounts of lignite, overburden and water that can still be removed from

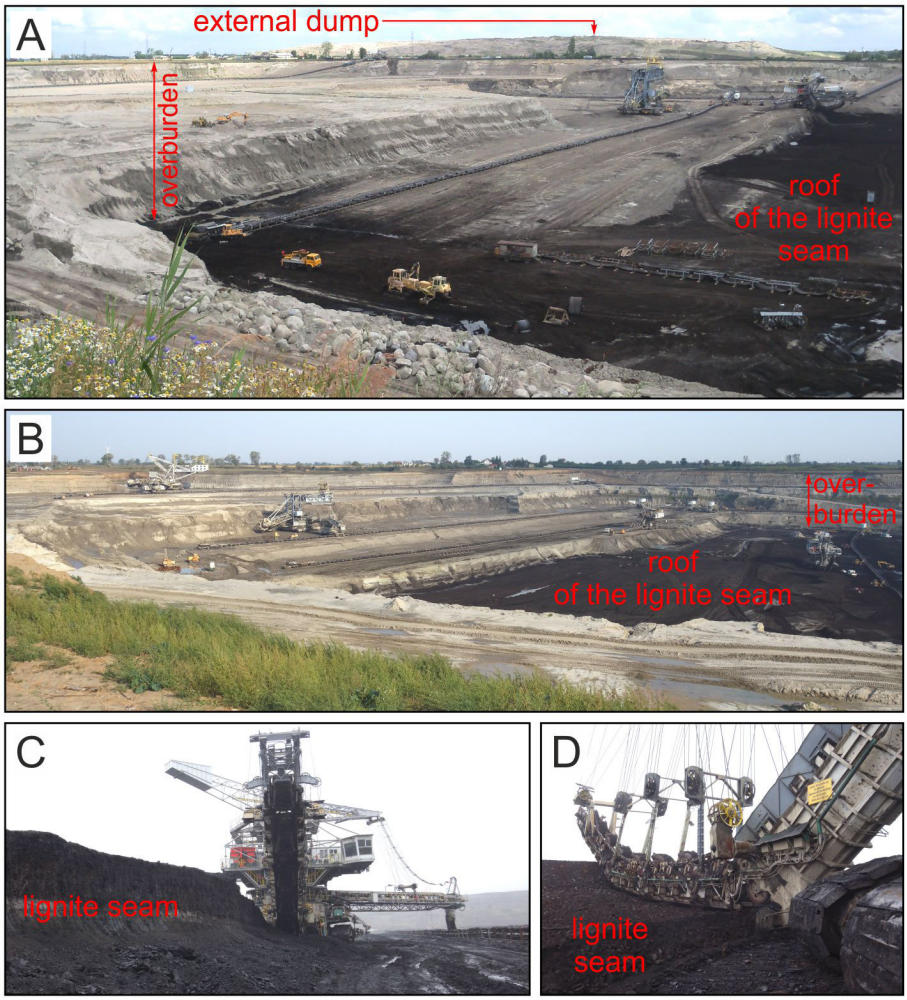

Fig. 9. Tomisławice lignite opencast. **A**, **B** – Broad view showing the lignite seam roof and overburden in mid-2024; **C**, **D** – Lignite mining by a multi-bucket chain excavator (photographs by M. Widera).

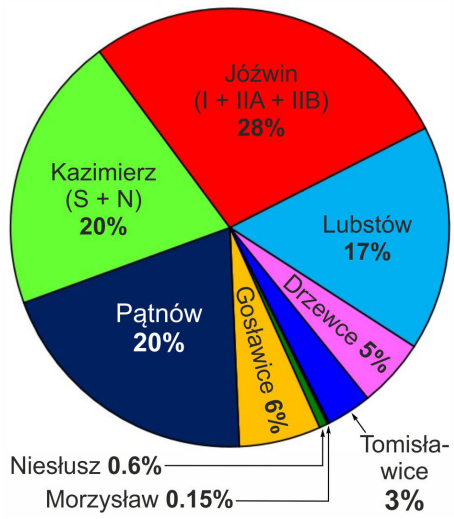

Fig. 10. Share of individual opencasts in total lignite mining in the Konin Lignite Mine (KLM) in the years 1945–2024 (based on mining data).

the Tomisławice opencast area are negligible in relation to what has been removed in the history of KLM, i.e. in the years 1945–2024. This allows some summaries to be made (Fig. 10; Table 2). During this time period, a total of 646.1 million tonnes of lignite were exploited, most of it from the Jóźwin opencasts (I, IIA, IIB), namely over 178 million tonnes, which accounts for 28 per cent of total KLM output. Twenty per cent of the lignite was exploited in each of the Pątnów and Kazimierz (S, N) opencasts, and 17 per cent in the Lubstów opencast. However, in the remaining opencasts, <15 per cent of lignite was mined in total (Fig. 10).

In the years 1945–2024, ~3.6 billion m^3 of overburden was removed and ~6.1 billion m^3 of water was pumped out in KLM (Table 2). From an economic point of view, in addition to the resources/reserves and the technological and chemical parameters of lignite given above, the so-called geo-

Table 2. Lignite exploited, water pumped out, overburden removed and basic geological and mining parameters for the Konin Lignite Mine (KLM) opencasts (based on mining data for the years 1945–2024).

Lignite opencast	Lignite (mill. tonnes)	Water (mill. m^3)	Overburden (mill. m^3)	Water-to-lignite ratio	Overburden-to-lignite ratio
Morzysław	1.0	no data	3.1	no data	3.1
Niesłusz	4.1	199.0	8.5	4.6	2.1
Gosławice	38.9	199.0	77.6	4.6	2.0
Pątnów	129.8	1,393.0	563.8	10.7	4.3
Kazimierz (S + N)	131.8	1,132.8	877.7	8.6	6.7
Jóźwin (I + IIA + IIB)	178.3	1,722.9	1,423.2	9.6	8.0
Lubstów	107.3	437.6	322.8	4.1	3.0
Drzewce	32.7	668.3	166.3	20.0	5.1
Tomisławice	22.2	587.7	151.4	26.5	6.8
Total	646.1	6,141.6	3,594.3	9.5	5.6

Fig. 11. Agricultural direction of reclamation in the post-mining areas of the Konin Lignite Mine (KLM). **A –** Sugar beet field; **B –** Sunflower field; **C –** Rapeseed field; **D –** Bee hives located near the phacelia field (photographs by Z. Kasztelewicz).

logical and mining parameters are very important. It is worth mentioning the overburden-to-lignite and water-to-lignite ratios here. In the case of larger opencasts, both of these ratios are the most favourable for the Lubstów opencast: 3.0 and 4.1, respectively. In turn, the overburden-to-lignite ratio of 8.0 is the least favourable for the Jóźwin (I, IIA, IIB) opencasts. However, it should be noted that the water-to-lignite ratio is very high, reaching 20.0 for the Drzewce opencast and as much as 26.5 for the Tomisławice opencast (Table 2).

So far, nine external dumps have been created near the opencasts (see Fig. 1). They are 8–70 m in height and cover an area of 25–408 hectares. In addition, each opencast has its own internal dump, and the final pit, created after the mining of lignite and overburden, is or will be filled with water. These areas have been subject to regular reclamation since the 1970s, mainly for agricultural, forest, water and recreational purposes (Figs. 11–13; Galantkiewicz, 2010; Kasztelewicz, 2010; Fagiewicz, 2016). In total, KLM has reclaimed >7,600 hectares during recent decades. The agricultural direction of using post-mining areas predominates, both on the tops of external dumps and on internal dumps (Figs. 11, 12A). In turn, forest reclamation is carried out mainly on the slopes of external dumps (Fig. 12).

By the beginning of 2025, water reclamation in eight opencasts had been completed (Fig. 13A–C). These water reservoirs have a maximum volume of up to 149 million m^3 and a depth of up to 63.7 m – the Kleczew reservoir (Kazimierz N opencast). Howev-

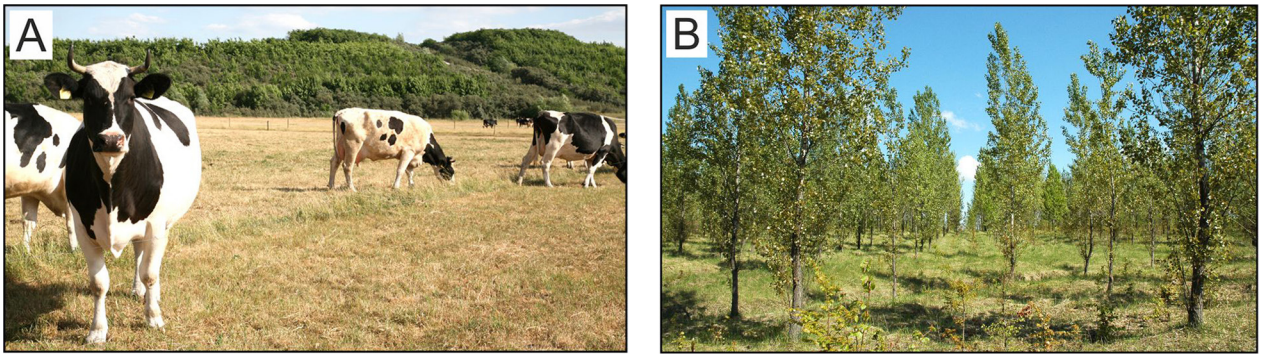

Fig. 12. Agro-forestry and forestry direction of reclamation in the post-mining areas of the Konin Lignite Mine (KLM). **A –** Meadow with cows in the foreground and forested external dump in the background; **B –** Forested external dump (photographs by Z. Kasztelewicz).

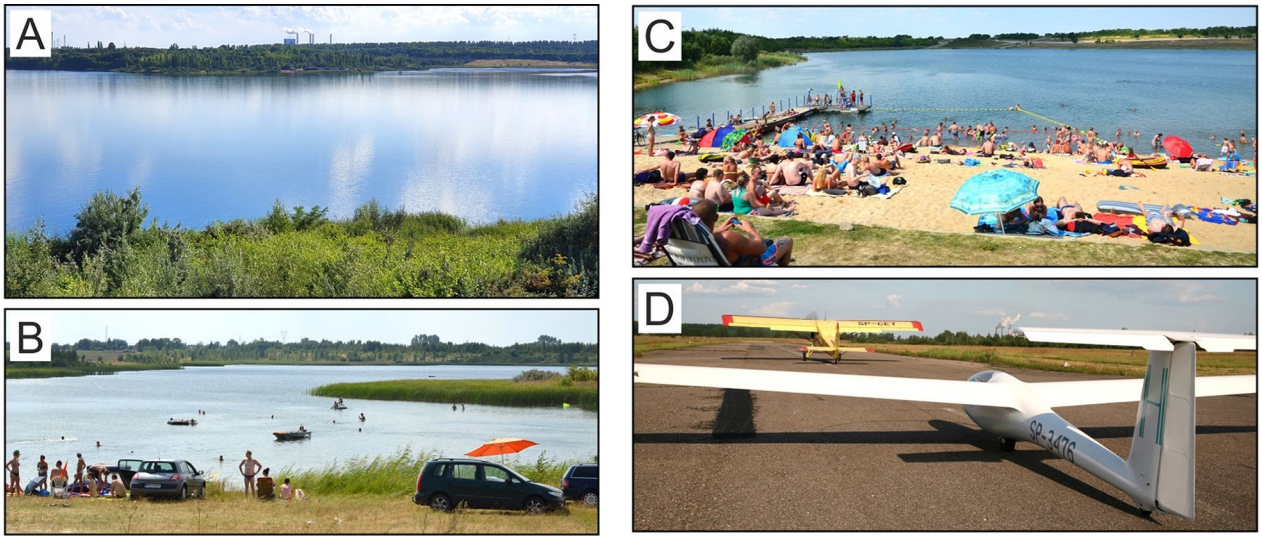

Fig. 13. Water, recreation and other directions of reclamation in the post-mining areas of the Konin Lignite Mine (KLM). **A –** Water reservoir after the Pątnów lignite opencast in Mikorzyn; note the Pątnów lignite-fired power plant in the background; **B –** People relaxing near, on and in the water reservoir after the Kazimierz S lignite opencast in Kozarzewek; **C –** People relaxing near and in the water reservoir after the Jóźwin I lignite opencast in Kleczew; **D –** Airport on the internal dump of the Kazimierz S lignite opencast in Kazimierz Biskupi; note the Pątnów lignite-fired power plant in the background (photographs by Z. Kasztelewicz).

er, the planned reservoirs will even have a depth of 68.7 m and a volume of 240 million m^3 – the Jóźwin reservoir (Jóźwin IIB opencast). Their main parameters (i.e. depth, area and water value) were published by the authors in another paper (Frydrychowicz et al., 2024, table 5). Some of these water reservoirs, for example, in Kozarzewek (Kazimierz S opencast) and in Kleczew (Jóźwin I opencast), are adapted for water recreation, including water sports (Fig. 13B, C). Other such post-mining lakes are used as storage sites for ash from lignite combustion in the Pątnów and Konin power plants. The water in these is strongly alkaline (pH >11–13) due to the relatively large amount of calcium carbonate (e.g., Fagiewicz, 2016; Frydrychowicz et al., 2024). Simply put, the lignites from the Konin region are rich in $CaCO_3$, and additionally, certain amounts of it are added during the combustion process to desulphurise fly ash (Chomiak & Widera, 2020). It is also worth mentioning a special field of recreation, which is aviation and gliding. This is carried out at the airport, which is located on the internal dump of the Kazimierz S opencast (Fig. 13D).

Currently, there are two open-air museums where KLM mining machinery and equipment is on display. The first one is located in Konin-Gosławice (near the District Museum in Konin, on the shore of Gosławskie Lake), the second in the north-easterly outskirts of the town of Kleczew (see Fig. 1). For more information and photographs from both open-air museums, reference is made to Frydrychowicz et al. (2024).

4.3. Future prospects of KLM

It is expected that lignite mining at the Tomisławice opencast will end in 2026 or 2027 (Frydrychowicz et al., 2024). This opencast will certainly be the last in the >80-year-history of lignite mining in the Konin region. Most likely, subsequent power units/blocks will be successively turned off in the near future at the Pątnów Power Plant (Widera et al., 2024b). Therefore, within the context of national and EU climate policy, electricity will be produced from renewable sources in post-mining areas. The construction of wind farms will continue on KLM dumps, and perhaps photovoltaic farms will also be built, generating solar energy (Widera et al., 2024a).

At this point, it should also be mentioned that changes await the Konin and Pątnów power plants, which used lignite from KLM for decades. Since 2012, the Konin Power Plant has been burning only wood biomass. From the last weeks of 2024, the modernised biomass units (2 x 50 MW) are also used to produce so-called green hydrogen. In contrast, the Pątnów Power Plant was planned to be replaced by a nuclear power plant, which was to be built by Polish companies, together with Korean companies. However, recent press reports have indicated that the government has not yet made a final decision in this matter – the construction of a gas power plant is now being considered.

Currently, the reservoirs left after the Lubstów (final phase), Drzewce and Jóźwin IIB opencasts (initial phase) are still being filled with water. However, filling the reservoir left after the Tomisławice opencast will begin after the end of lignite mining there. The areas left after these opencasts and water reservoirs must be tidied up and properly managed. In connection with this, KLM will subject ~3,000 hectares to a multi-directional reclamation process in the unspecified future (Frydrychowicz et al., 2024).

In the coming years, the project of reconstructing the excavator–belt conveyor–stacker technological line on the eastern edge of the Jóźwin IIB lignite opencast will be continued. At the end of 2023, a 'Dolores' excavator, weighing ~2,650 tonnes, was brought to the ground surface (see Frydrychowicz et al., 2024, fig. 11E); it could extract 5,400 tonnes of lignite or overburden per hour (Galantkiewicz, 2010). Thus, after adding a part of the belt conveyor and the stacker, it will be the third and largest open-air museum of mining machinery in the Konin region. It seems reasonable to assume that in the near future, it will also be the greatest attraction for fans of post-industrial culture in central Poland.

5. Discussion

At least three issues related to the mining activities of KLM require a brief discussion. First, we need to answer the question of what impact lignite mining has had on the economic development of the Konin region. Secondly, what impact did it have on the natural environment. And thirdly, what significance did lignite mining near Konin have on our understanding the geology of central Poland?

The existence of KLM has resulted in the establishment of other plants using its lignite (i.e. briquette factory, power plants) and cheap electricity from these lignite-fired power plants (e.g. the Konin Aluminium Smelter, the Opencast Mining Equipment Factory and many others). At the end of communist times in the late 1980s, over 8,200 people worked in KLM, exploiting ~15 million tonnes of lignite per year (Kasztelewicz, 2004), while in 2024, <400 employees were responsible for mining ~0.9

million tonnes of lignite. This is, of course, related to the improvement of work efficiency in KLM over the last 3–4 decades. At the end of the 1980s, Konin had almost 80,000 inhabitants, which was a nearly seven-fold increase compared to the early 1950s (Kaliński, 2017). Generally speaking, it was then that the Konin region became one of the richest in Poland thanks to lignite mining and the energy industry based on it (Frydrychowicz et al., 2024).

In addition to lignite combustion, KLM has had the greatest direct impact on surface and underground hydrogeological systems. The process of opencasts dewatering, by pumping out ~6.1 billion m^3 of water, results in the drying of groundwaters (e.g., Habel et al., 2023) and, above all, the development of deep (up to 50–60 m) underground water depression cones (Przybyłek, 2022). They reach from a few to several kilometres from the edge of the lignite opencasts, causing a decrease in the water table (up to 3–6 m) in numerous nearby subglacial lakes (e.g., Przybyłek, 2018; Nowak & Przybyłek, 2020; Nowak et al., 2024). It seems that, without transferring water from nearby larger Polish rivers (e.g., from River Warta to the Jóźwin IIB opencast and from River Wisła to the Tomisławice opencast) to the recently closed opencasts, restoring the original level of underground and surface waters (including the above-mentioned natural lakes) may take many years.

The exploration of lignite deposits and their mining by KLM have provided a great number of drilling data and direct observations in the field. Their cognitive value cannot be overestimated, as they allow for a better understanding of the Cenozoic geology of central Poland, and the Konin area in particular. Over the last eight decades, numerous sediments, forms and structures have been identified in KLM opencasts. Some of these were so unique that stratotypes were designated for the Quaternary and Neogene stratigraphy of central Poland in the Konin region. In addition to numerous case studies, it is worth mentioning a range of dissertations, which were written largely on materials obtained directly from lignite opencasts or from KLM archives. All these achievements, which would not have been possible without mining activities in the Konin area, were described in detail by Widera (2025).

6. Conclusions

The history of Konin Lignite Mine (KLM) spans over 80 years, including 45 years in communist times and 35 years subsequently. The first of these periods covers the time of the centrally planned economy, when lignite mining in KLM gradually increased to nearly 15 million tonnes per year. Following this, when the mine became subject to the rules of a free market economy, the trend reversed, and lignite exploitation dropped to below 1 million tonnes in recent years.

Currently, only a single opencast is left; of those from which lignite has been mined throughout the entire history of KLM. The Tomisławice opencast will be the last one in the Konin region. At present, KLM also devotes a lot of attention to reclamation of post-mining areas and restructuring of nearby lignite-fired power plants, which is in line with Polish and EU climatic policy.

The future of KLM has already been decided, as lignite mining in the vicinity of Konin will end within 1–2 years. Then, reclamation works will remain to be done, including flooding of the last opencast, which may take a relatively long time. In addition, it is planned that green hydrogen or, depending on the variant adopted, electricity from nuclear energy or natural gas will be produced in former lignite-fired power plants.

To summarise, it should be said that for over 80 years, lignite mining has had a huge, positive impact on the social and economic development of the Konin region and its inhabitants. Many tourist, recreational and other attractions will remain after KLM, including open-air museums where mining equipment, reclaimed dumps and water reservoirs may be viewed. However, filling the last of them, as well as restoring the initial water level in the natural lakes of the Konin region, may prove to be great challenges for future generations.

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