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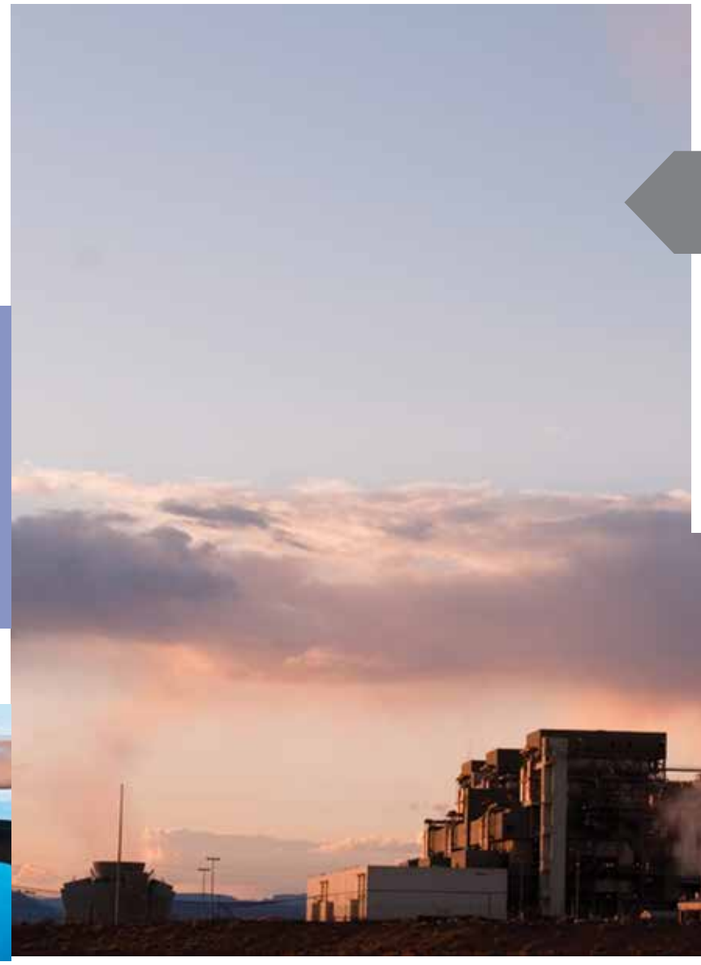

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Company plans to re-open Cape Breton mine after 2 years

A Cape Breton coal mine that was shuttered two years ago could reopen as early as this fall to cash in on the recent surge in coal prices, a local politician said.

James Edwards, a regional councillor, says the mine's owners, Kameron Collieries ULC, recently told a community liaison committee that plans are in the works to restart operations at the Donkin underground mine.

"There are several provincial regulatory permits that are required," Edwards said in an interview. "If they were to get all of the required permits tomorrow, it would still take 90 days to resume operations."

The company, a subsidiary of The Cline Group LLC, did not respond to a request for comment.

"It's great news for the area," said Edwards, whose district in eastern Cape Breton includes the mine. "The primary consideration, of course, is safety, regardless of the price of coal on the world markets.

He said the company is hoping to have the mine operating in the fall of this year.

The mine was shut down in March 2020 amid slumping coal prices and repeated government stop-work orders following roof falls. More than 100 people lost their jobs at that time.

Kameron Collieries said it decided to cease production due to "adverse geologic conditions." That decision followed a roof fall on 13 February, 2020. No one was injured, but Nova Scotia's Labour Department suspended operations and sought remediation plans.

When the mine started production in February 2017, it was the first underground coal mine to operate in Nova Scotia since 2001. Its twin tunnels extend three kilometres under the Atlantic Ocean.

The rebirth of underground mining in Nova Scotia was seen as a godsend for an economically depressed region desperate for well-paying jobs. But the mine had its share of challenges.

During its three years of operation, there were 12 incidents where rock fell from the ceiling of the mine's tunnels, according to Morien Resources Corp., which holds a royalty interest in the Donkin mine.

"These occurrences are very common to underground coal mining operations," Morien said in a statement in April 2020. "In Donkin's case, all of the roof falls occurred in areas where the risk was already identified by Kameron, and precautionary measures had been taken."

Since the closure, the mine has been maintained by a small staff. They ensure it is ventilated and kept dry.

Meanwhile, coal prices in the United States surged to an all-time high in March as Russia's war in Ukraine and an economic rebound from the COVID-19 pandemic have spurred demand for fossil fuels.

The Donkin mine can produce low-ash, high-energy metallurgical and thermal coal. Metallurgical coal is used primarily for steelmaking, and thermal coal is used in generating electricity.

Europe imports more South African coal as Russian ban looms

European countries, scrambling to secure alternatives to Russian coal, imported 40% more coal from South Africa's main export hub in the first five months of this year than over the whole of 2021, figures obtained by Reuters showed.

South Africa's Richards Bay Coal Terminal (RBCT) delivered 3,240,752 tonnes of coal to European countries by end-May this year, 15% of RBCT's overall exports, up from 2,321,190 (4%) in 2021, the figures showed.

Starting the second week of August, Russian coal imports will be banned in the European Union, part of wide-ranging sanctions on Moscow.

RBCT did not immediately reply to a request for comment. RBCT usually provides figures annually, and does not give a comprehensive breakdown of export destinations.

The Netherlands, Italy, France, Spain, Denmark, Poland, Germany, and Ukraine have received coal from RBCT so far this year. Some of them only began importing from RBCT after Russia invaded Ukraine on 24 February.

Germany to reboot mothballed coal-power plants after Putin throttles gas supply

Germany will pass emergency laws to reopen mothballed coal plants for electricity generation ahead of the winter as Russian cuts to gas exports threaten shortfalls in Europe's largest economy.

Moscow cut capacity on the main gas export pipeline to Berlin last week by 60%, trigging alarm across Europe at the prospect of fuel reserves running out as countries cut ties with the Kremlin following its invasion of Ukraine.

Italy, which has also been his by falling gas supplies, is also expected to announce emergency measures in the coming days if supplies aren't restored by the Russia's state energy company Gazprom.

The German government said it would significantly increase its use of highly polluting coal to preserve energy supplies and auction gas supplies to industry to encourage businesses to curb consumption.

The plan is at odds with Germany's climate policy, which aims to phase out coal by 2030, and has set the preliminary targets to cut emissions by at least 65% by 2030 compared to 1990 levels, and 88 percent by 2040. It is aiming to hit net-zero greenhouse gas emissions by 2045.

Economic minister Robert Habeck, a Greens MP in the coalition government, said bringing back coal-first power plants was "painful" but "a sheer necessity".

"To reduce gas consumption, less gas must be used to generate electricity. Coal-first power plants will have to be used more instead," he said recently AEST. "This is bitter but in this situation essential to lower the use of gas."

Habeck said he was working to temporarily bring back up to 10 gigawatts of idle coal-fired power plants for up to two years, which would increase Germany's dependence on coal for electricity generation by up to a third.

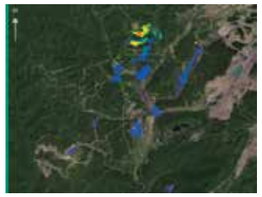
"The situation is serious," Habeck said. "It is obviously Putin's strategy to upset us, to drive prices upwards, and to divide us…We won't allow this to happen."

The government recently called on citizens to cut back their energy use in light of the tense supply situation.

Berlin has come under intense criticism, particularly from the United States, for its reliance on cheap Russian energy sources, which Washington has always seen as a security risk for Europe.

Rising energy prices are stoking inflation and a cost of living crisis across Europe, which central banks are struggling to address without tipping the region's economy into recession.

Russia's unprovoked invasion of Ukraine has had far-reaching impacts on the global energy system, disrupting supply and demand patterns and threatening to derail efforts to tackle the world's efforts in reducing global greenhouse emissions in time to meet targets.



Huge burst of methane from Russian mine detected by satellite

A satellite managed by GHGSat, a commercial emissions-monitoring firm, observed thirteen plumes of methane at the Raspadskya mine, the largest coal mine in Russia, in late January. About 90 tons an hour of the greenhouse gas was being released from the mine. This would be enough to produce natural gas to power 2.4 million homes.

The mine seems to be leaking methane at a lower rate now, about a third of the highest rate recorded in July – but it's still an important methane contributor. Furthermore, the leak is believed to have been active for at least six months before January's survey. GHGSat said the leak is about 50% bigger than any other leak seen since it started its global satellite monitoring back in 2016. Russia hasn't reported the leak on its end.

In 2015, the biggest methane release in US history happened in an underground natural gas storage facility in Los Angeles. GHGSat estimates up to 58 tons an hour of methane was released. Three years later, GHGSat identified a malfunctioning oil well in Turkmenistan, which released 142,000 tons of methane between 2018 and 2019.

New Wyoming facility to boost extraction of REEs from coal

Companies and researchers developing asphalt, graphene, graphite, agricultural char, and carbon fibre and extracting rare earths from coal and coal byproducts, now have a 9.5-acre site to work on their innovations.

Recently, non-profit Energy Capital Economic Development officially opened the Wyoming Innovation Center (WyIC), a 5,500-square-foot coal commercialisation facility located on a reclaimed mine site in the US' coal-rich "Carbon Valley" region. This area hosts 65 billion tons of recoverable coal.

Built under a $1.5-million grant from the Wyoming Business Council and a $1.46-million grant from the US Economic Development Administration, the WyIC features two buildings and seven demonstration sites for pilot plants, for private companies and researchers to advance coal-to-product and rare earth element processes.

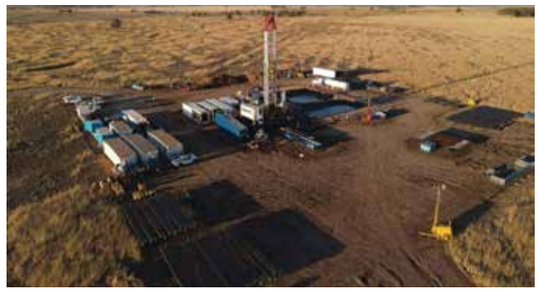
In a press release, Energy Capital Economic Development said that tenants at WyIC will focus on evaluating the commercial viability of high-value nonfuel, low- or zero-emissions products made from coal and extracting REEs found in coal fly ash.

Previous studies have shown that the region's Powder River Basin coal contains high extractable rare earth element content in portions of the coal seams – particularly in the coal ash materials produced at power plants.

"It's the perfect destination for us to fulfill our mission – to research and develop the commercialisation of rare earth elements," Tom Tarka, an engineer at the National Energy Technology Laboratory (NETL), said. NETL focuses on applied research for producing and using clean energy resources and is the Wyoming Innovation Center's first tenant.

According to Tarka, in addition to the massive facilities, the main draw of the WyIC is the 7.5-acre demonstration sites that function as an open-access platform for tenants to upscale lab-proven processes from using a few pounds of coal a day to processing up to several hundred pounds of coal or coal by-products daily.

North Antelope Rochelle coal mine in Wyoming.



Japanese investment in Glencore carbon capture project

Japan-based Marubeni Corporation and Electric Power Development will each invest $10 million in Glencore's CTSCo Carbon Capture and Storage (CCS) Project in Queensland.

Both Marubeni and J-POWER are long term joint venture partners in Glencore's mining operations in Australia.

The Project aims to demonstrate carbon capture and storage technology, focusing on capturing CO2 from the Millmerran coal-fired power station and permanently storing it deep underground in a dedicated storage site 100 kilometres from the power station.

CTSCo has the potential to store significant volumes of CO_2 to reduce existing and future sources of industrial emissions, which could improve energy security for the national electricity market, maintain and grow jobs in regional Queensland and enable future industries including hydrogen production, while also contributing to Australian and Queensland Government climate and emission reduction goals.

A comprehensive Environmental Impact Statement for the Project is currently in progress, working towards the commencement of CO_2 injection in 2025.

Marubeni's Materials Group chief executive officer Jun Horie said the company was delighted to participate in the first CCS project in Australia to capture CO_2 from a coal-fired power plant.

"CCS is an important technology in enabling a carbon neutral economy worldwide, not to mention Japan. We hope to bring back what we learn from this project to contribute to the industry's emission reduction goals."

Glencore's Global Coal Assets head Earl Melamed said the practical application of CCS and the technology would contribute to decarbonisation in Australia and all over the world as well.

"CTSCo is one of the most advanced onshore CCS projects in Australia and has the potential to store significant volumes of CO_2 from a number of industries while playing an important role in deploying this critical emission reduction technology and bringing down its costs. Marubeni and J-POWER are long-term investors in the Australian resources sector and their involvement in our project further highlights the potential for CCS to materially reduce emissions in Queensland."

UK spent £5bn on Russian energy imports last year

The UK spent around £5 billion on imports of Russian oil, gas and coal in the year to April 2022 according to a House of Commons research briefing, as the government looks to halt supplies by the end of this year.

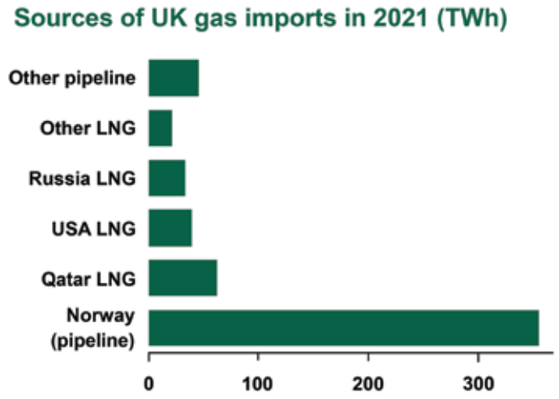
Imports from Russia made up 4% of gas used in the UK last year, alongside 9% of oil and 27% of coal, the report finds.

The figures highlight the scale of the challenge faced by the UK and other economies as they look to sever Russian supplies in the wake of its invasion of neighbouring Ukraine.

The UK spent £1.1bn on around 1.4 million tonnes of Russian gas during the period, supplies of which increased by 37% over the year.

Russia remained the fourth largest source of imported gas, after pipeline supplies from Norway and liquefied natural gas (LNG) supplies from Qatar and the US.

However, the UK sources additional supplies from Europe via pipeline, which may also contain gas originally produced in Russia that is later blended with other supplies.



Just under £3.8bn was spent on 7.8 million tonnes of imported Russian oil and oil products in the year up to April 2022, making it the UK's third largest source behind the US and Norway.

Notably, Russia was the second largest source of refined petroleum products and is "by far the most important source of imported diesel" the briefing said, accounting for around 20% of all UK supplies.

Around £200m was also spent on 1.9 million tonnes of Russian coal, making it the largest supplier of the fuel to the UK last year.

While overall quantities of Russian imports fell substantially between April 2021-22 – by more than 70% in the case of oil and coal – higher commodity prices meant the trade value of these imports did not fall by the same amount.

Earlier this year business secretary Kwasi Kwarteng said the UK will "phase out" the import of Russian oil, oil products and coal by the end of this year, while exploring options of doing the same for Russian LNG "as soon as possible thereafter".

An LNG tanker docked at the Sakhalin 2 project in Russia.

The Polish government wants to lower prices

A government spokesman says there is a plan to shorten coal supply chains to households with the help of Treasury companies by removing middlemen so that prices drop despite the crisis.

The government spokesman, Piotr Müller, informed in an interview with Polsat News about the planned changes.

The government wants to change the supply chain, which is to have a positive effect on the price of the raw material. – We want to use State Treasury companies to shorten the supply chains. Eliminate intermediaries and the margins they impose, because they are currently very large – even several hundred PLN – said Müller.

UK Government closes in on deal with EDF to extend life of coal plant as it scrambles to secure supplies

The government is preparing to finalise an agreement to continue operations at a coal-fired power station that was set to close this autumn.

Downing Street is desperate to ensure the security of the UK's energy supplies this coming winter, and has been holding talks with the plant operator EDF to extend the life of the West Burton A Power Station in Nottingham from October to March next year.

City A.M. understands a deal could be reached this week, with the French energy giant negotiating the price with the government, Ofgem and the National Grid's Electricity System Operator (Grid ESO).

An EDF spokesperson told City A.M.: "EDF is working hard to finalise an agreement with Grid ESO to support the government's request to keep West Burton A Power Station available over next winter. An update will provided at the appropriate time."

The West Burton A Power Station was opened in 1966 and was due to close last year, but has already had its life extended until September.

Despite the plant's stay of execution, EDF is only prepared to potentially to cover next winter, with plans to plant closing down as a mixture of both government policy and because the French energy giant deemed it had reached the end of its lifespan.

However, EDF has run a full safety check on the plant, meaning operations could continue over the winter if necessary.

Meanwhile, the government has maintained 2024 as the final deadline for coal operations in the UK.

It is only looking to secure a standby arrangement with EDF for the plant to remain available for back-up generation, according to The Financial Times, which could provide enough power for about 1.5m homes.

There are three coal-fired power stations still operating in the UK, following a decade-long switch from coal to natural gas as the base-load source for meeting the country's energy needs.

The government is also in discussions with Drax about reopening its coal terminal at the power group's plant in Yorkshire, and part of Uniper's Ratcliffe-on-Soar coal plant in Nottinghamshire.

Both plants are due to close in September.

The units could generate electricity for about 4m homes when running at full capacity.

Why Australia should NOT feel guilty about ramping up coal power to deal with the energy crisis

Australia using more coal power to alleviate the energy crisis will make no difference to global warming because huge nations like China, India and others are building hundreds of new power plants and throwing emissions targets out the window, according to Barnaby Joyce.

The new Labor government is urging coal power plants to increase output as soon as possible as the east coast shivers through a freezing winter and global gas prices soar.

The Greens – who have blocking power on any government bills in the Senate – have argued this is the wrong approach and have instead called for a massive and rapid investment in renewable energy to get to net zero carbon emissions by 2035.

But former deputy prime minister Mr Joyce said Australia's actions will make no difference to global temperatures given both China and India are pushing ahead with more coal power.

'China's had record production of coal in the past two quarters. If Australia were to disappear off the face of the earth, China would cover for us in about a month,' he told Daily Mail Australia.

China makes up about 29% of global CO_2 emissions while Australia emits about 1%.

Last year China was responsible for 56% of the world's new coal power capacity, ahead of India on 14%, South Korea on 7% and Indonesia on 6%.

Despite holding large reserves of coal, Australia has not built new coal power capacity since 2012 even as energy prices soar.

China's new capacity almost offset all the coal plant retirements in the world, according to the Global Energy Monitor.

A report last year by think-tank Carbon Tracker found China, India, Indonesia, Japan and Vietnam were planning to build 600 new plants between them.

China aims to reach net zero by 2060 but has signalled it will roll back its commitment for emissions to peak in 2030 after suffering power outages causing blackouts in major cities last year.

Premier Li Keqiang said in October that energy security is the priority ahead of climate goals.

nergy security should be the premise on which a modern energy system is built and the capacity for energy self-supply should be enhanced,' he said in a statement as he pledged to build more coal plants and drill for more oil and gas.

Australia's 11 step plan to manage gas crisis

Australia's energy ministers have unanimously agreed to enhance the powers of energy regulators and give the market operator the capacity to procure and store gas supplies.

Energy Minister Chris Bowen chaired a roundtable with his state and territory counterparts, where 11 action points were unanimously agreed to.

Mr Bowen says the changes will give Australia the tools and capacity to manage the gas crisis going forward.

'No silver bullet, no magic answers, but material steps forward in a very positive fashion,' he told reporters following the meeting.

'The Australian Energy Market Operator could not procure some gas and keep it in reserve to be released for urgent and crisis situations.

'That is technically possible. There's storage facilities around the country. We agreed to work to give AEMO that power and to give them that power expeditiously.'

Regulators will also be given more powers to ensure transparency in the market and that retailers work in the best interests of consumers.

The Australian Energy Market Commission has been instructed to proceed with the development of the capacity mechanism which ensures power plants are available to generate electricity when needed.

The development of a national transition plan for the energy market ahead of the next meeting in July has also been agreed to.

'The reason why we are in this crisis today is because there hasn't been enough planning about the changes that are necessary,' Mr Bowen said.

'That's the result of poor planning and a previous government which didn't see the opportunities for transmission, didn't see the opportunity to renewable energy.'

Resources Minister Madeline King says unexpected outages of coal-fired power plants were adding to pressures on the energy grid as gas companies work to increase their output.

'Existing coal fired power stations going offline due to planned and unplanned outages combines to see this extraordinary price,' she told Sky News.

NSW Treasurer and Energy Minister Matt Kean said the state's coal-fired power stations needed to increase their output following the unexpected outages, to act as a stopgap with surging gas prices due to the war in Europe.

'When we've got coal-fired power plants that are not in operation due to unscheduled outages, that means gas is filling the gap,' he said.

'We need to get our coal-fired power stations back cranking up. We need our power stations running at full tilt during the winter period, so we're less reliant on gas and can put downward pressure on electricity prices.'

The domestic gas supply guarantee coming into play is also helping to provide some relief to the east coast, but prices will not drop substantially overnight, Ms King added.

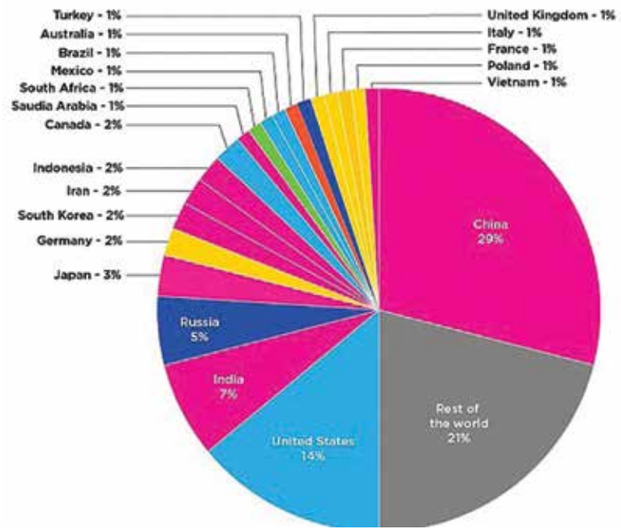
'The gas … is going to where it needs to be and that should flow through the system,' she said.

'I'm not saying we're going to see a massive reduction in prices overnight. We're certainly not because we still need those … existing coal fired power stations to come online. But the gas is moving around, more gas has been supplied.'

The ACT is set to become the only Australian jurisdiction to experience a small decrease in electricity prices off the back of large-scale renewable energy projects coming online, its economic regulator says.

Prime Minister Anthony Albanese said coal would remain a part of the energy mix, while Mr Bowen earlier warned there was no easy fix to the energy crisis as the nation was ill-prepared to manage it.

Treasurer Jim Chalmers is awaiting advice from the competition watchdog on the role and impact of coal-fired power plant shutdowns on energy prices and what regulations could be used.



This pie chart show which nations are most responsible for global CO_2 emissions.

India, where millions are without electricity, has rejected the 2050 target for net-zero emissions because it would hinder growth and poverty alleviation, and had set 2070 as its target.

The south Asian nation is responsible for 7% of global emissions, behind the US on 14% but ahead of Russia on 5%.

Coal accounts for nearly 70 percent of India's electricity generation and about three-quarters of the fossil fuel is mined domestically.

Energy Minister Chris Bowen said Australia must act to reduce emissions to show 'leadership' on the world stage.

While China's overall coal consumption has increased, viewed as a share of its total energy usage it has started to come down as the country has used more natural gas – and started to develop renewables and nuclear energy

The world still has more than 2,400 coal-fired power plants operating across 179 countries, including 19 in Australia and 1,110 in China.

In October China increased coal power production after power outages were reported in southern Guangdong province.

An additional 16 provinces were forced to ration energy due to a shortage in supply, but avoided full-scale blackouts.

In response, Shanxi – China's biggest coal-producing region – ordered its 98 coal mines to raise their annual output capacity by 55.3 million tonnes and allowed 51 coal mines that had hit their maximum annual production levels to keep producing.

In China's second biggest coal region, Inner Mongolia, 72 mines were told that they could operate at higher capacities immediately,

A power station in Victoria.

provided they ensure safe production.

This year European nations have ordered increased coal production as a temporary measure to wean themselves off Russian gas following Moscow's invasion of Ukraine.

Germany has drafted laws to prevent coal power stations destined for the scrapheap from being axed, ordering them to be kept on standby instead.

Italy, Bulgaria, Romania and the Czech Republic also plan to burn more coal and the UK is drilling for more gas in the North Sea.

If temperatures continue to rise, there could be devastating effects on Earth, including a dramatic loss of sea-life, an ice-free Arctic and more regular 'extreme' weather PM Anthony Albanese denies.

About a quarter of Australia's coal-fired electricity production is offline due to planned and unplanned outages.

Anthony Albanese declared he was fine with firing up more coal power despite campaigning on a plan to phase down fossil fuels to fight climate change.

The Prime Minister blamed the Coalition for Australia's energy crisis, insisting the former government failed to properly invest in renewables and the electricity grid during its nine years in office.

About a quarter of Australia's coal-fired electricity production is offline due to planned and unplanned outages, while the east coast shivers through a freezing winter.

With gas supplies dear and energy bills set to skyrocket, Resources Minister Madeleine King on Tuesday called on coal power stations to increase their output as soon as possible.

Speaking in Darwin on his way back from a trip to Indonesia, Mr Albanese denied this move contradicted his climate ambitions.

Asked if he is 'uncomfortable' with relying on more coal power, the Prime Minister replied: 'Not at all' and later added: 'Coal is part of our mix right now'.

Anthony Albanese has declared he is fine with firing up more coal power despite campaigning on a plan to phase down fossil fuels to fight climate change.

Mr Albanese wants renewables to supply 82% of electricity by 2030. Pictured: Williamdale Solar Farm, 35km south of Canberra

About 60% of Australia's electricity comes from coal, 32% from renewables and 8% from gas.

Labor wants cheaper renewable sources to supply 82% of electricity by 2030, claiming this will save households $275 a year by 2025, and $378 by 2030.

Mr Albanese admitted that international factors including Russia's invasion of Ukraine were driving up energy prices but said Australia is less able to deal with the shock due to the Coalition's energy policies.

'One of the problems that has occurred here is a failure of investment because the former government had 22 energy policies, and didn't land one,' he said.

About a quarter of Australia's coal-fired electricity production is currently offline while the east coast shivers through a freezing winter amid soaring price rises

'You don't have a grid that's fit for purpose in the 21st century.

Labor's Rewiring the Nation plan will bring forward $20billion worth of grid upgrades identified by the Australian Energy Market Operator.

'We didn't make this up. This is what the experts… (were) recommending to the Government, and nothing happened,' he said.

'Nothing happened for nine years. And this is a direct consequence of that.'

He added: 'There are international factors, but it's also the factor of a failure of the former government to actually have an energy policy.'

Mr Albanese said if the grid was 'fit for purpose' and could take in more renewable energy then 'you would have a real alleviation on pressures that are in place right now.'

Greens leader Adam Bandt (second left) insists that burning more coal is not the answer to rising power prices

The Greens have blasted Labor's call for more coal and insisted a rapid investment in renewables is the way to go.

'Propping up these aging plants would be throwing good money after bad,' leader Adam Bandt told Daily Mail Australia.

'No amount of patching up these dirty clunkers will fix the problem.'

He said Australia should follow the example of the ACT which has generated all of its electricity from renewables since 2020.

While the east coast braces for soaring prices, power bills in the ACT are set to fall from July 1, providing an annual saving to households of $23.

The ACT is currently paying less than a quarter of the NSW market price for its electricity because it relies on solar and wind and is less vulnerable to global price shocks.

AGL currently has three coal power stations in NSW and Victoria either offline or on reduced capacity due to scheduled and unscheduled maintenance issues.

Origin's Eraring power station, the largest in NSW, has also been crippled by coal production cutbacks at its neighbouring conveyor belt-connected coalmine.

It's had to buy coal on the open market as prices surge because of the global crisis sparked by the war in Ukraine, which forces electricity prices up further.

Queensland's Callide coal power station is also offline after an explosion at the plant, creating a perfect storm just as the bitter cold snap hit Australia's east coast.

The maintenance work at affected power stations is not expected to be completed until July at the earliest while Callide is out until December, but Labor is demanding the work is now fast-tracked.

Haver & Boecker Niagara optimises mining operations with NIAflow Software

Haver & Boecker Niagara offers NIAflow plant simulation software. NIAflow helps producers optimise quarry and mine operations by diagramming plant flow, machine placement, product pre-calculations and more.

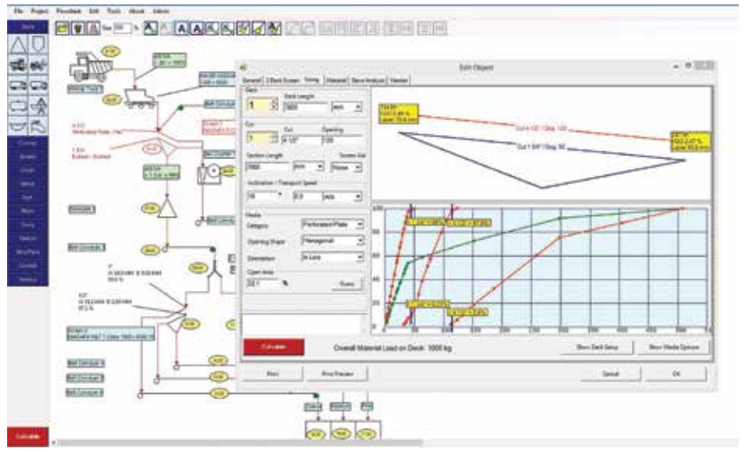
Developed by Haver & Boecker Niagara engineers, NIAflow instantly analyses existing or proposed processes, records plant statuses, and recognises potential for plant optimisation. The software is available for download on Windows-based systems. NIAflow supports the user in every engineering phase, from drafting flow diagrams for product pre-calculation to plant start-up and simulating parameter changes. Its intuitive menu control makes it easy for all levels of experience, and Haver & Boecker Niagara provides several levels of training, if needed. These can be group, company or even individual training sessions.

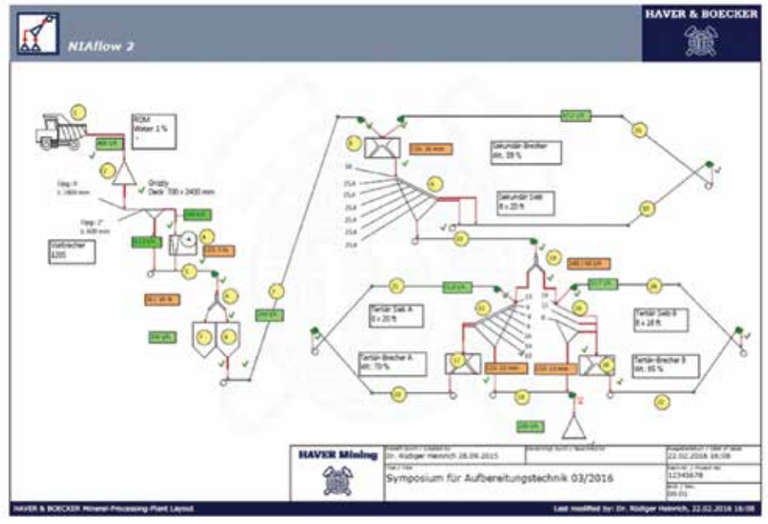
"As part of our ongoing efforts to optimise plant efficiency for our customers, we are constantly developing innovative machines, programs and software to help them be successful," said Karen Thompson, president of Haver & Boecker Niagara's North American and Australian operations. "NIAflow will serve as a cornerstone in the development of process engineering projects. When paired with other Haver & Boecker Niagara technology, such as Pulse vibration analysis software, our customers will hold all of the tools they need to optimise process flow and increase productivity and profits."

NIAflow allows users to analyse more than 90 different process equipment pieces, from crushers and vibrating screens to material washers and conveyers. Beyond equipment, the system uses scientific-based methods to monitor the operation's input, output and waste piles. The program calculates the mass and volumetric flow rates as well as the valuable content with machine-specific operating parameters to prevent plant bottlenecks before equipment is in place.

"NIAflow will significantly impact the efficiency and profitability of our mineral processing customers," said Joachim Hoppe, Haver & Boecker Niagara Mining general manager. "The thought process behind this software development was to give our partners tools to closely monitor their plant setup as a whole, allowing them to identify problems and plant bottlenecks. NIAflow helps producers discover the most efficient set up for existing equipment as well as determine equipment needed to enhance productivity and increase production."

NIAflow is available for purchase for aggregates and mining. The NIAflow Aggregates version is the extensive, full version of the NIAflow simulation software that allows unlimited machine input. NIAflow Mining complements the Aggregates full version, but offers additional equipment options, such as classifying and sorting equipment.





The past, present and future of coal-fired power in South Africa

Much has changed since the Komati Power Station in Mpumalanga went into commercial operation in the 1960s. With the Medupi Power Station in Limpopo having entered full commercial service in 2021 – and as South Africa battles with regular power cuts – it is worth seeing how much has changed over the years.

The comparisons in scale are perhaps most noticeable. While any power station, to the average outsider with limited engineering knowledge, is an impressive sight to behold, comparing the inner workings of South Africa's oldest and newest coal-fired power plants is illuminating and gives us an insight into decades of technological progress.

It also offers a glimpse into how South Africa has cemented its status as one of the largest pollution emitters on the planet.

In November 2021, *Our Burning Planet* was given an inside look at how Eskom's Komati Power Station works. Currently the oldest operating station in the utility's coal fleet, it has generated electricity since 1961 and is scheduled for decommissioning by the end of this year.

At present, it is the site of a pilot project to develop solar-powered microgrid systems to provide power to far-flung and underserved areas.

The past – Komati Power Station

According to Eskom's website, Komati Power Station's "ultimate capacity was to be 1,000 kilowatts produced by five generators of 100,000kW each and four generators of 125,000kW each".

At the time of its completion, it was envisioned that the station would need 12,000 tons of coal a day.

Komati Power Station general manager Marcus Nemadodzi explained to *Our Burning Planet* how his station works.

After being transported from the mine to the station, coal is pulverised to a very fine powder in large mills. This finely pulverised coal powder is then blown into a boiler furnace where combustion occurs.

The walls of the boiler furnace are lined with hundreds of metres of boiler tubes and water is converted into steam.

This hot, high-pressure steam is directed to the turbines.

"As the steam passes through the turbine at high velocity, it expands and gives up a part of its energy to the turbine rotor which drives the generator at 3,000 revolutions per minute," Eskom explains on its website.

"At the turbine exhaust end the steam temperature is only about 100°F and its pressure is about 12 lbs per square inch below atmosphere, i.e. nearly that of a perfect vacuum.

"To attain this low temperature and pressure, the steam has to be condensed at the low pressure" and for this purpose a "large quantity of cooling water is pumped through tube nests inside the condenser. The condensed steam is extracted from the condenser and, after passing through various heaters, is returned to the boiler for reuse."

Eskom's website goes on to explain that "a 100,000kW turbine requires about 4,000,000 gallons of cooling water per hour for its condenser. The temperature of this water is raised about 15°F while passing through the condenser and it has to be cooled again before it can be reused.

"For this purpose, it is pumped into the cooling towers where it is cooled partially by evaporation and partially by warming the air that flows into the bottom and out of the top of the cooling towers."

One of the coal mills at Komati's Unit 9 on 8 November 2021.

The coal furnace used to power a turbine at the Komati Power Station in Mpumalanga.

Inside the Komati Power Station on 8 November 2021. It is one of the oldest remaining coal-fired power stations in South Africa.

A community outside Komati Power Station.

Komati is now in the final months of its operational life.

Coal's role in South Africa's energy mix is far from over, however, with Eskom planning to bring more coal-fired generating capacity online, while the Department of Mineral Resources and Energy plans to keep it as part of its energy mix.

The Medupi Power Station in Lephalale, Limpopo, offers an insight into how much the technology has changed over the decades since Komati was first fired up.

The present – Medupi

On Eskom's website, they explain that Medupi is a coal-fired power station comprising six units rated in total at 4,800 megawatts of installed capacity.

When it finally achieved commercial operation status in 2021, it was the largest dry-cooled power station in the world, and the fourth-largest coal-fired power plant on the planet.

In May 2022, *Our Burning Planet* was afforded the opportunity to see the inside of this modern behemoth.

Acting plant general manager, Zweli Witbooi, explained how Medupi works. "We are a six unit station generating 794MW gross, but sending 720MW to the grid."

Exxaro's Grootgeluk coal mine provides the plant with a steady supply of coal for its 7km-long conveyor. It has enough coal to supply the power plant until the end of its life. The plant is designed to operate for 50 years.

Witbooi explained that the coal is stored at a 10,000 ton silo and fed on to conveyors which move the coal into bunkers and then directly into the coal mills. At these mills, like at Komati, the coal is pulverised into a fine powder.

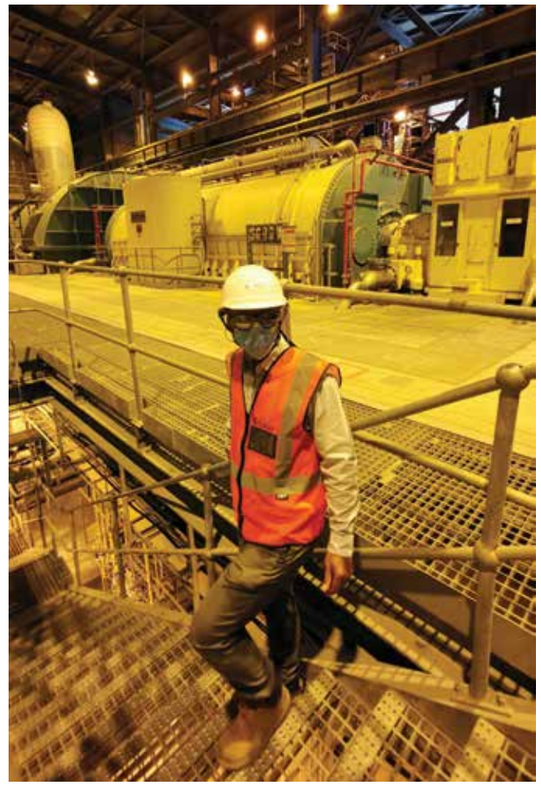
Fans then blow that fuel into the boiler. This is followed by the combustion process, which includes various stages of heating water to become steam.

The power plant uses supercritical technology with its boilers and turbines that operate at higher temperatures and pressures than Eskom's older plants.

The steam from that

Medupi Power Station in Lephalale, Limpopo.

The massive coal mills at Medupi Power Station.



Medupi Power Station acting general manager, Zweli Witbooi, in front of the massive turbine and generators.

process is sent to the turbine in stages with a high-pressure, intermediate-pressure and two low-pressure stages.

This connects to the generator which, at full speed in Medupi, is able to produce 794MW per generating unit, which then goes to the grid.

To get a better sense of just how much electricity that is, Witbooi explained that if there was Stage 1 load shedding, losing one of these 794MW units could result in Eskom taking the country to Stage 2.

Unlike Komati, Medupi Power Station is air-cooled, which means you won't see the usual tell-tale cooling towers emitting condensation and steam into the sky.

Instead, the plant is cooled by dozens of huge fans. This is meant to offset some of the potential environmental impacts of the plant on the area's already scarce water resources.

Eskom says that "Medupi is also built ready for the installation of abatement technology such as flue gas desulphurisation, which will reduce sulphur dioxide (SO2) emissions by more than 90%.

"It will also include pulse jet fabric filters, which will remove approximately 99% of particulate matter, and low NOx burners that reduce nitrogen oxide emissions. All of this will have an effect of reducing the environmental impact on ambient air quality."

However, the reality differs.

Medupi continues to face a number of design defects. These include high furnace gas temperature and high reheater spray flow, milling plant defects, poor performance of the pulse jet fabric filter, poor performance by the gas air heater and duct erosion.

Efforts are under way to fix these problems, with early indications of success in rectifying the defects in the mills.

Medupi Power Station employees work on one of the mills.

The future – Integrated Resource Plan

South Africa's Integrated Resource Plan 2019 envisions adding more coal-powered generation capacity into the country's energy mix.

"Beyond Medupi and Kusile, coal will continue to play a significant role in electricity generation in South Africa in the foreseeable future, as it is the largest base of the installed generation capacity and it makes up the largest share of energy generated.

"Due to the design life of the existing coal fleet and the abundance of coal resources, new investments will need to be made in more efficient coal technologies (HELE technology, including supercritical and ultra-supercritical power plants with CCUS) to comply with climate and environmental requirements."

In a webinar on 17 May 2022, Dr Fatih Birol, executive director of the International Energy Agency, responded to Our Burning Planet's questions about South Africa's plans to build new coal power plants.

"First of all, I would like to say that when we talk about coal, we should not forget that many – if not all – advanced economies today realised their economic development, their economic progress, by using a lot of coal in the 1950s, 1960s and as a result put a lot of emissions in the atmosphere.

"Now, today, developing countries – South Africa, Indonesia, India – they use a lot of coal, and if we want to see their coal use decline, advanced economies have to support them in phasing out coal.

"It is, in my view, an economic and moral responsibility of the advanced economies. This is number one," he said.

Birol continued: "Number two. Yes, there are technologies that can help us, such as carbon capture and storage, to use coal without having emissions. Again, this would require a substantial amount of financial assistance from the advanced economies.

"And third," said Birol, "we should not forget the fact that coal is not only a problem for climate change – for global emissions – but it is also a problem for local pollution… for the citizens of those countries.

"Therefore, there is a need in those countries – it can be South Africa, it can be Indonesia – for governments to come up with strategies to reduce the share of coal in a timely manner with the help – financial help – of the advanced economies to reduce coal use… not only to support the global fight against climate change, but also for the health and benefit of their own citizens." OBP/DM

The global explosives market

The global explosives market size is expected to grow from $40.60 bn in 2021 to $42.30 bn in 2022 at a compound annual growth rate (CAGR) of 4.2%. The growth in the market is mainly due to the companies resuming their operations and adapting to the new normal while recovering from the COVID-19 impact, which had earlier led to restrictive containment measures involving social distancing, remote working, and the closure of commercial activities that resulted in operational challenges. The explosives market is expected to reach $49.87 bn in 2026 at a CAGR of 4.2%.

Industrial explosives companies are using advanced technologies for explosion activity and blasting systems. New and innovative explosive technologies enable pumped loading methods across dry, wet and dewatered hole conditions. Companies in the mining explosives market and construction explosives market are boosting research into new technologies to allow efficient blasting operations. For example, in 2021, Orica Limited, an Australian-based provider of commercial explosives and blasting systems, launched its new 4D explosives technology that allows customers to target specific blast outcomes in real-time. The major benefits of using advanced technologies in explosives include improved bulk strength for hard rock applications; a broad range of applications; and improved blast outcomes.

Major players in the global industrial explosives market are Orica Mining Services, Sasol Limited, Austin Powder Company, Dyno Nobel, NOF Corp., BME Mining, China Poly Group, Chemring Group, Maxam Corp., and ENAEX.

The global explosives market is segmented by type into C4, HMX, PETN, RDX, dynamite, ANFO, others; by application into military, mining, quarrying, construction, others; by pyrotechnics application into display, consumer, procimate, others.

Asia Pacific was the largest region in the explosives market in 2021. Western Europe is expected to be the fastest growing region in the forecast period. The regions covered in the explosives market are Asia-Pacific, Western Europe, Eastern Europe, North America, South America, Middle East, Africa.

Explosives Global Market Report 2022 – Market Size, Trends, And Global Forecast 2022-2026 is one of a series of new reports from The Business Research Company that provide explosives market overviews, analyse and forecast market size and growth for the whole market, explosives market segments and geographies, explosives market trends, explosives market drivers, explosives market restraints, explosives market leading competitors' revenues, profiles and market shares in over 1,000 industry reports, covering over 2,500 market segments and 60 geographies.

The report also gives in-depth analysis of the impact of COVID-19 on the market. The reports draw on 150,000 datasets, extensive secondary research, and exclusive insights from interviews with industry leaders. A highly experienced and expert team of analysts and modelers provides market analysis and forecasts. The reports identify top countries and segments for opportunities and strategies based on market trends and leading competitors' approaches.

Thai Miner Banpu using coal windfall for cleaner fuel transition

Thailand's largest coal miner Banpu Corp. is planning to take the windfall profits it's currently making from the fossil fuel and use them to become a cleaner energy company.

Banpu is aiming to reduce the proportion of revenue it generates from coal from around two-thirds now to 50% by 2025, according to Chief Executive Officer Somruedee Chaimongkol. It will replace those earnings with a mixture of natural gas production and power generation, as well as green technologies including solar and carbon capture, she said.

"This is a good time for us to speed up our transformation process," Somruedee said in an interview. "We expect coal prices to remain high through next year, which will help maintain our strong cash flow. We will use this strength to invest in greener businesses in bigger scale."

The dirtiest fossil fuel is enjoying a revival after shortages in China last year saw the government encourage more mining and Russia's invasion of Ukraine pushed up energy prices across the board. That's threatening to slow the pace of decarbonisation in many economies, but is a boon for miners like Banpu, which saw a sixfold jump in profit in the first quarter from a year earlier.

The Thai company is planning $1.3 billion of capital expenditure this year, with $750 million of that going on a deal to buy natural gas assets in Texas from Exxon Mobil Corp. that's expected to be concluded this month. Those assets will be added to its American unit, BKV Corp., which the company is planning to list in the US, Somruedee said.

Banpu will look to invest $800 million to $1.3 billion per year through 2025 to expand its gas and green portfolio, she said. The company – which currently has solar plants in China, Japan, Australia and Vietnam – will also look at opportunities in floating and rooftop solar, as well as gas-fired power plants and pipelines, according to Somruedee.

She didn't specify how much of the target of 50% of revenue coming from non-coal assets would be from renewables and what proportion would be from gas. Somruedee also said that while Banpu expects to see its coal portfolio shrinking over the longer term, the 2025 goal would be tough to reach.

"It will be challenging to reach the target amid high coal prices," she said in the Thursday interview. "We can't just exit the coal business now. What we are trying to do is phase down."

NEWS, PLANT AND EQUIPMENT

Rich nations may fork out billions to wean Indonesia Off Coal

Ever since Indonesia accelerated plans last year to achieve carbon neutrality, a parade of climate envoys from developed nations has headed to the archipelago, offering assistance and financial aid in exchange for a commitment by the world's biggest exporter of coal by weight to phase out coal power.

Officials from the U.S. and Europe hope to secure a deal by the time Indonesia hosts G-20 leaders in Bali in November, establishing a major milestone in the global effort to cut emissions and providing an impetus for the United Nations' COP27 climate summit in Egypt the same month.

It's an ambitious goal. Coal generates about 60% of Indonesia's electricity and the fossil fuel has made fortunes for some of the nation's most powerful business elites. The war in Ukraine has lifted global demand, boosting the stocks and profits of coal-mining companies, making them even more attractive for investors. Meanwhile, the nation's monopoly power distributor gets coal for its power plants at a discount, giving it little incentive to hook up renewable-energy suppliers.

Rich nations are betting that agreements known as Just Energy Transition Partnerships will help break the deadlock and provide fossil fuel-dependent nations such as South Africa and Indonesia with the financing and support to speed up the transition. Donors must "break the status quo," said U.S. climate envoy John Kerry in April.

Yet three people from donor countries with knowledge of the talks, who visited Indonesia this year, raised concerns privately that Indonesian President Joko Widodo's cabinet is split over the need to end the use of coal. Some want to continue building the coal sector, negotiators said. Others are seeking billions for each shuttered coal plant and some factions would like to continue building them, said Jake Schmidt, senior strategic director of the international climate program at the Natural Resources Defense Council, who monitors the discussions.

"That's not what the donor countries" envision, Schmidt said. "The framework is basically stop building new coal and begin to decline," but "there are parts of the Indonesian government that are not quite there."

Publicly, the Indonesian government has made a strong commitment to rein in coal and develop green energy. Dian Triansyah Djani, Co-Sherpa for Indonesia's G20 presidency and ambassador to the UN, said the country welcomes the discussions toward the Just Energy Transition Partnership. Jokowi, as the president is known, has pledged to shut all Indonesia's coal-power plants by 2055 and be 100% dependent on renewable sources five years later. No new coal-fired power plants will be approved and there are plans to finally roll out a carbon tax in July.

Those targets will be tough to meet without a deal with wealthy nations, as well as detailed regulations that force power users and generators to switch to clean energy. A government study said the nation will need $150-$200 billion investment in low carbon programs annually until 2030, or roughly 3.5% of GDP, to meet its net-zero targets.

"If they don't have a comprehensive dialogue and a comprehensive strategy, it's unlikely that the transition will happen," said Stephan Garnier, Indonesia energy coordinator and lead energy specialist at the World Bank.

Indonesia is one of a handful of resource-driven nations that could make a major difference in the battle to curb climate change. Southeast Asia's biggest economy has the world's fourth biggest population and is the second-biggest coal producer. Coal output began to soar in the 1990s and powerful local investors snapped up controlling interests in some mining companies, augmenting the wealth of a largely decentralised elite class. Predicting a boom in demand for electricity, Indonesia began to invest heavily in coal power, a trend that continued under Jokowi.

Rich Nations Scramble to Seal Coal Transition Deals Before COP27

In 2015, he launched a program to build 35,000 megawatts of new power capacity largely supported by an additional 117 new coal-fired power plants. By 2020, electricity output had grown more than five-fold over nearly two decades.

But growth in demand didn't keep up. When the added capacity comes online, and some of it is years behind schedule, it could create a power surplus of as much as 40%, according to the Institute for Essential Services Reform. The country's biggest grid, covering Java and Bali, already has 24% more capacity than it needs, according to BloombergNEF. That has driven domestic coal power costs well below international market rates, squeezing out renewables.

The nation's 2030 goal is to reduce emissions by between 29% and 41%. Officials have said the country can reach the low end of the band with measures such as mixing plant debris in with coal, retiring older power stations early and reducing subsidies, but it will need foreign assistance to achieve more.

"Because of this oversupply of coal, going beyond that by 2030 will be difficult," said Garnier.

Much could depend on talks between donors and South Africa, which has led the field in terms of establishing a JETP. Ambassador Djani said Indonesia is in talks with South Africa about the structure and implementation of the partnership.

But even if all goes well in South Africa, Indonesia has its own set of unique issues to overcome. The government requires coal miners to sell at least a quarter of their supplies domestically with prices capped at $70 a ton for the highest quality, compared with recent prices of around $400 a ton in the global market. That means state utility PT Perusahaan Listrik Negara can produce electricity from its power plants more cheaply than the cost of producing green power. Worse still, PLN signed take-or-pay contracts with the coal plants, many of which operate well below capacity. So when demand increases, PLN can draw more power from them at zero extra cost, which is tough to beat, no matter how cheap solar is.

Investments in clean energy "must follow PLN's timeframe and needs, with no other recourse if a deal with PLN doesn't work out," said Fabby Tumiwa, executive director at the Jakarta-based Institute for Essential Services Reform. "A reform to the electricity market structure so that PLN is not the single off-taker would quicken the shift to renewables."

And coal remains the heart of Indonesia's energy supply, with production at record levels. Even with the moratorium on new projects, coal-fired power plants already under construction will add another 14 GW of capacity from 2021-2030. This year, Jokowi broke ground on the nation's first coal gasification plant, which will cost $2.3 billion.

In coal-mining regions such as East Kalimantan, proposed site of Indonesia's new capital, coal accounts for almost half the economy, according to Tumiwa at the IESR. Increased demand from abroad since the war in Ukraine has sent shares in mining companies soaring. Shares of miner PT Adaro Minerals Indonesia have jumped more than 1,500% since its public debut in January. As many as half of the 575 lawmakers in parliament have connections with the mining sector, according to the Indonesia Mining Advocacy Network, which investigates the crossover between officials and business.

"Countries have always relied on the resources available to them to increase electrification rates and drive economic growth," said Caroline Chua, an analyst with BloombergNEF. "In Indonesia, that resource was coal."

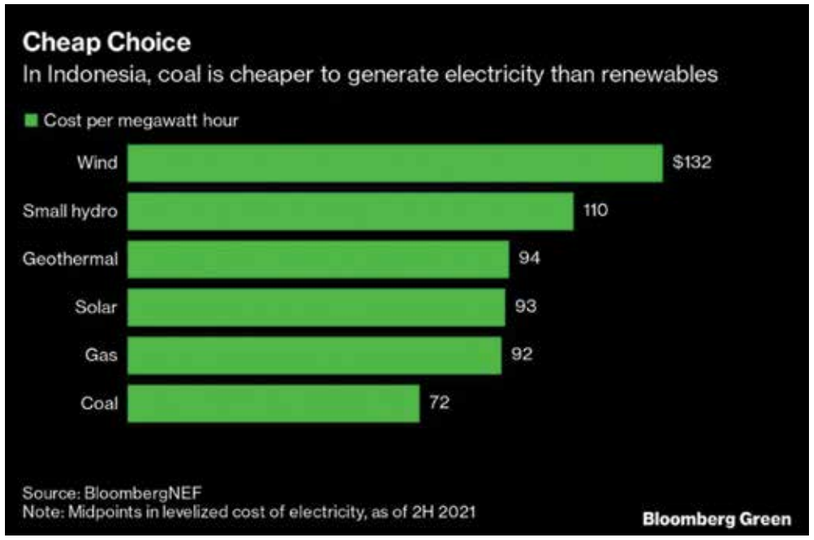
Indonesia has the theoretical potential to meet the entire world's electricity demand from renewables, according to an IESR study last year, but it has fewer solar panels than Norway and has barely begun to tap abundant wind and geothermal resources. Lifetime costs of solar projects in Indonesia could be as much as 40% lower if finance and investment risks were comparable to those in advanced economies, according to the International Energy Agency.

Still, there are some signs of progress. The Asian Development Bank last year launched a multi-billion dollar plan that aims to help Indonesia and the Philippines retire 50% of their coal plants over the next 10 to 15 years. Indonesia, in turn, has said it will retire some of the power stations earlier than scheduled if they meet the end of their economic life-cycle, a plan Tumiwa says could involve as much as 9.3 gigawatts of capacity through 2030.

And despite all the obstacles, negotiators are optimistic that a deal can be reached this year.

"Indonesia will be our next partnership," US Treasury Climate Counselor John Morton said at an event with the Center for Global Development in early May. "If this were easy, it would have been done years ago. Countries could have managed this on their own," he said. "We're talking about economy-wide economic transitions of energy sectors, which are huge political beasts."

(Michael Bloomberg, the founder and majority owner of Bloomberg LP, the parent company of Bloomberg News, is funding efforts to close a quarter of the world's remaining coal plants and cancel all new proposed projects globally by 2025.)



Mining company New Hope Group says it's ready for controversial mine expansion

Mining company New Hope Group says it is one step closer to approval of its controversial Stage 3 coal mine expansion in Queensland's Darling Downs after a report by the Coordinator General was handed down.

Key points:

- After five months of extensive consultation, New Hope Group says the government can now finalise a new coal mine
- The controversial New Acland expansion has been held up in court for 15 years
- Oakey Coal Action Alliance Members say there are still approvals to be given before the mine expansion is a done deal

However, a lobby group of landholders against the project said there were still obstacles for the expansion, and the recent federal election result "showed Queenslanders did not want more coal mines".

Late last year, the Queensland Land Court conditionally approved the expansion of the New Acland coal mine on the Darling Downs.

A report was then to be prepared by the Coordinator General, which was handed down late last week.

The report outlined conditions to be incorporated into the New Acland Stage 3 Environmental Authority.

New Hope Group chief executive Rob Bishop said the decision on approving the lease was now before the Queensland government.

"New Acland Stage 3 has been extensively reviewed, assessed and scrutinised," Mr Bishop said.

"The Land Court process and the Coordinator General's consultation process has allowed everyone to have their say about the project.

"This historic development is a green light for finalisation of the approvals process and means we can now focus more on plans to re-open the mine and recruit our workforce."

Report instills confidence in mine staff

Mine manager Dave O'Dwyer said the report had given him confidence the project would move forward.

"The Coordinator General has looked across all the things that were talked about in the Land Court and pulled that all together, so it really develops a framework for the EA [environmental assessment]," he said.

Mr O'Dwyer said it was the "first step, first domino, ready to fall and the rest should should come along after".

"We're confident we'll be talking weeks and months, not years," he said.

Late last year, the mine ran out of coal and was forced to let go most of its remaining workers and go into caretaker mode.

Water rights may still be an obstacle

But Paul King from the Oakey Coal Action Alliance (OCAA) said the process was not that simple and the implications for groundwater for nearby farmers had not been considered enough in the land court process.

"The approval that New Hope still needs is the approval of the minister, and they need a water licence," he said.

"So both of those still remain obstacles."

Mr King said the lobby group would pursue legal action over groundwater next.

Without the associated water licence, New Acland cannot interfere with groundwater and therefore cannot mine coal.

"We're absolutely prepared to defend the water rights of the farmers in that district, absolutely prepared for that," Mr King said.

"And there's nothing that stops us from doing it."

Mr O'Dwyer said the mine was committed to not taking groundwater and was confident it could meet the requirements for the water assessment process.

'Queenslanders don't want more thermal coal'

The planned expansion has been the subject of legal battles for well over a decade, with the OCAA comprising more than 60 local landholders opposing the project.

Mr King said OCAA would be meeting with the Resources Minister Scott Stewart on Friday.

He said he would be telling the minister that the recent federal election result had shown Queenslanders did not want more coal mines.

"Even people in regional Queensland know that we need to transition, that's not lost on them," Mr King said.

"They're not stupid, they know that, so it would really be a retrograde step now to turn their backs on the farmers of that district in favour of thermal coal mining, because it just won't pay in the long run, economically, or politically."

The Queensland government has long maintained it would only consider granting approvals for the mine once all legal processes were finished.

Mr Scott told the ABC that all resources projects must stack up environmentally, socially and financially.

"The Coordinator-General has released a Change Report on the New Acland Coal Mine Stage 3 project as directed by the Land Court," he said.

"The report has been provided to the Department of Environment and Science to consider as part of the Environmental Authority process.

"The Department of Environment and Science must include the Coordinator-General's stated conditions in an amended Environmental Authority for the project, before a mining lease can be granted.

"This was the process set out by the Land Court."

New Hope Group first applied for approval for its Stage 3 expansion in 2007.

Since then, it has been stalled by legislative demands and protracted legal challenges.

The OCAA first lodged a legal challenge against the project in the Land Court in 2016.

The hearing lasted almost 100 days, becoming the longest in the court's history.

The report will now be put before the Department of Environment and Science, which will work with New Hope Group on the environment assessment.

Edenville terminates mining deal with Nextgen at Rukwa

Edenville Energy updated the market on the operation of its Rukwa coal project in Tanzania, announcing the termination of its coal mining agreement with Nextgen.

The AIM-traded firm had said on 18 May that it was in discussions with Nextgen Coalmine to vary the contract for the operation of Rukwa, entered into on 3 February.

It confirmed that it had reached an agreement with NextGen to terminate the contract, and had subsequently resumed full control of the site and mining operations.

Following the termination of the contract, all mining equipment was brought back into service by the company, while an additional pre-strip excavator was added to the fleet.

Up to three additional trucks were also being sourced to "rapidly scale" production.

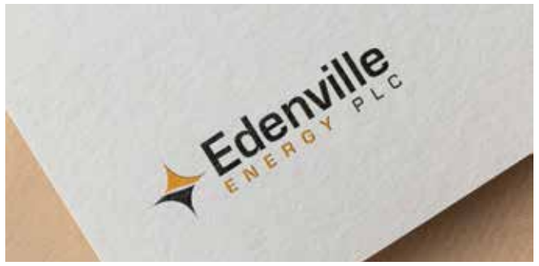
The firm said its initial goal was to satisfy existing demand from local customers of 1,500 tonnes of washed lump coal product, and 500 tonnes of coal fines in the immediate future, targeting sales of 5,000 tonnes per month of washed coal late in the third quarter of 2022, with coal fines sales also expected to continue and possibly expand. Edenville said it believed there was "sufficient demand" based on its existing order book and recent discussions with potential customers to sell any coal produced at Rukwa.

Additionally, further to its announcement on 18 May that Upendo Group's current 10% economic interest in the joint venture that holds the Rukwa licences had been transferred to a 10% direct holding on the principal production licence, the company said it was still in talks with its legal advisers regarding the validity of the transfer and consequences thereof.

"The agreed termination of the agreement with Nextgen will enable the company to take advantage of the recent macro changes that have made the economics of our Rukwa project considerably more attractive," said chief executive officer Alistair Muir.

"The company is determined to maximise cash returns in the current global coal environment, especially given the attractive pricing forecast over the coming years.

"To this end Edenville has already started applying a modest proportion of its existing cash resources towards expanding the Rukwa operations to meet this heightened demand."



New tools for enhanced geological modelling

Micromine has released the latest version of its industry-leading exploration and resource estimation solution, Micromine Origin 2022.5.

The enhanced functionality of the company's flagship product is led by three vital brand new tools to equip exploration and resource geologists with even greater confidence in their geological decisions.

At the click of a few buttons, users can improve the accuracy of their resource estimates by effortlessly integrating real deposit geometry into their estimations with the new Structural Trend tool.

The new Vein Network tool facilitates all veins to be modelled in a single step, mitigating the typical time-consuming macros and manual boolean operations. This provides an ideal solution, especially when modelling vein deposits with multiple loads or complex intrusion-style deposits.

Due to the high risk for over or underestimation, Micromine Origin 2022.5's new Indicator Grade Shell tool mitigates estimation risk and prevents domain errors by providing an unbiased and accurate method to represent grade domains.

Micromine's Chief Strategy and Product Officer, Kiril Alampieski, said Micromine had always been the tool of choice for explorers worldwide.

"Therefore, a significant focus on the 2022.5 release has been on strengthening our geological and resource modelling tools to ensure we remain at the forefront of mining software," he said.

"The three key new tools, amongst the other new tools featured in this release, are instrumental in making life easier. Essentially, we want geologists to be able to prospect smarter and model faster."

There's also a boost in performance efficiency with Micromine Origin 2022.5, including 3D GIS, block modelling, and charting.

"Regarding wireframes, there's a 90% loading and unloading speed improvement, and wireframe sets with shaded draw styles now render over 100x faster," Alampieski said.

"Furthermore, the Implicit Modelling tool's 'points per sphere' are auto calculated, resulting in up to 65% performance improvements and more precise outputs."

Coal production jumps by 34 pc to 71.30 MT in May

India's coal production increased by 33.88% year-on-year to 71.30 million tonnes (MT) in May 2022 as compared to 53.25 MT recorded during the same month last year, government data showed.

New atomised mist cannon manages dust in unfavorable weather conditions

The next advancement in industrial dust suppression has been introduced by the leader in atomised mist technology, a powerful cannon that is designed to fight dust with maximum efficiency. Developed in response to the needs of customers in areas with variable winds, the DustBoss® DB-60 Surge® features water propelled at high velocity from a center nozzle, combined with the industry-proven fan and misting ring system. With three remote-controlled stages and precision oscillation for optimum command over water volume and coverage area, the cannon uses high-powered jets that surge through the wind for over 250 feet (76.2 m) to suppress both surface and airborne dust. The result is effective and versatile dust mitigation in challenging weather for outdoor operations ranging from demolition to bulk material processing and storage.

"Our customers operate in very different circumstances; some with high-reach excavators, some in open areas without natural barriers, while others are located in narrow corridors where wind velocity is amplified," explained BossTek Dust Control Specialist Mike Lewis. "What these customers have in common is the difficulty in controlling fine atomised mist during blustery conditions. So we worked with our industry partners, listened to their feedback and engineered our most versatile and innovative machine to date."

Lewis recalled that one of the initial drivers behind the new design was a need in the demolition industry. "Several customers described their challenges in suppressing dust during demolition of high-rise structures," he said. "Some of them use attachments that can be mounted on a high-lift boom, but that can bring its own complications. When we started working on a solution, we realised that this technology would also deliver benefits to a wide range of applications in which variable wind conditions can be a problem, such as port facilities, material processing operations and large outdoor storage facilities."

The DB-60 Surge combines the power of an industrial fan, misting ring and heavy-duty barrel with the reach and force of a central high-pressure spray nozzle. The pressurised spray resists wind shear and even uses the force of the wind to further fragment and carry the droplets, enhancing its dust suppression capabilities. This is achieved without the need for the high water output associated with a hydrant-dependent hose or industrial sprinkler system.

In high-wind situations, dust is lifted into the atmosphere and carried beyond the site line over long distances, which can lead to permit violations. Operators of bulk storage mounds, demolition sites, ports, recycling material piles, etc. often mitigate particulate emissions using a sprinkler or hose to saturate a material's surface. The higher the wind, the more water pressure is required to break through the

shear, resulting in greater amounts of water filling the surrounding work area -- often 300 GPM (1135 lpm) or more.

There are several issues associated with the use of hoses and industrial sprinklers. Hoses typically require manual labor, removing workers from other critical tasks. Moreover, both sprinklers and hand-held hoses contribute to high water bills. Taking compliance and expenses into consideration, the long-term cost of operation for sprinklers and hoses is higher than it might appear.

The DB-60 Surge addresses wind, labor and water usage issues. While striving to stay compliant with dust regulations, operators can now better match the water requirements to the specific application. Fed by a standard 1-½ in. (38 mm) hose with a cam-and-groove quick disconnect coupling, the powerful booster pump delivers as much as 500 PSI (27.5 BAR) of water pressure to the center nozzle, with an output of 37-100 GPM (140-378 lpm).

Controlled by a 3-stage system adjusted by a hand-held remote, the first stage is highly effective on moderate days for airborne and surface coverage. It uses the powerful 25 HP / 30,000 CFM (849.5 CMM) fan and misting ring to deliver millions of fine atomised mist droplets over a wide area, which collide with tiny dust particles and drag them to the ground. For windy days, stage two features a pressurised stream delivered by the central nozzle. On high wind days, operators can utilise the fan, misting ring and center nozzle for maximum coverage. [**Figure 1**]

The versatility and coverage area is extended with the customisable 359º horizontal oscillation range and 0º-50º vertical throw angle. Using the hand-held remote, the operator can raise the spray angle to reach extended heights, directing the 250 foot (76 m) spray to areas such as high-reach demolition or across

DB-60 SURGE WATER USAGE

OPERATING LEVEL	FLOW RATE @ 50 PSI	3.45 BAR
STAGE 1: OUTER SPRAY RING	30 GPM	114 LPM
STAGE 2: CENTER NOZZLE	70 - 100 GPM	265 - 378 LPM
STAGE 3: OUTER RING & CENTER NOZZLE	100 - 130 GPM	378 - 492 LPM

BOSSTEK 1-1/2" Hose Water Supply

Figure 1: Water volume of each stage.

The design features three remote-controlled stage and precision oscillation for optimum coverage.

The DB-60 Surge is built for versatility and continuous use in punishing outdoor weather conditions.

the beam of large bulk cargo ships. The oscillation range is easily controlled with the left and right trigger of the remote control to customise the precise desired horizontal range.

Mounted on a heavy-duty roadworthy trailer for towing at highway speeds with a standard ball hitch, it can be placed by a pickup truck, skid steer or lift truck wherever dust suppression is needed. As supplied, the DB-60 Surge can run potable or non-potable water, as it is equipped with two in-line 30 mesh, 595 micron filters to avoid clogging. One filter is located at the water entry point to the booster pump, another prior to the pipe feeding the central nozzle.

After the initial setup, the DB-60 Surge requires no labor to operate. The remote control has a 1000 foot (305 m) range, so operators using heavy machinery from high-reach excavators to front loaders can command the machine without leaving the cab.

Lewis mentioned that other options are already available, including tower mounting and a version of the company's popular Fusion lineup, which pairs the Surge with a generator to alleviate the need for a nearby power source.

"DustBoss is known for its rugged quality and long equipment life, often described as one of the most reliable and low-maintenance pieces of equipment on any job site," he added. "Our 3-year or 3000-hour warranty is evidence of our confidence in the products. The DB-60 Surge is designed with that same philosophy and is built to last."

Yankuang Energy says open to buying rest of Yancoal Australia

China's Yankuang Energy said that it was open to negotiations to buy the remaining shares in its majority-owned unit Yancoal Australia, after the Australian coal firm rejected a $1.8 billion offer.

Yankuang, which owns 62.26% of Yancoal's shares, said that it was considering offering Yancoal shareholders $3.60 per share in convertible bonds for the remaining 498.2 million shares not held by the company, which is a discount to the market price.

Yancoal said an independent committee it appointed to evaluate the potential transaction unanimously concluded that an acquisition by Yankuang would not be in the best interests of Yancoal's minority shareholders.

Shares of Yancoal rose 3% to A$5.58 ($3.99) in early trading.

Yankuang said in its statement that it remained open to further negotiation, adding it "looks forward to continuing its discussions" with Yancoal's independent board committee.

The Chinese energy firm said Yancoal's share price has inflated since the recent surge in coal prices, and its $3.60 offer was based on the stock's historic trading price and its own evaluation of how much the firm was worth.

Yankuang said its offer would also allow minority shareholders to convert their bonds into Yankuang shares if they wanted.

Reuters previously reported the offer was "unacceptable" to Glencore, which holds a 6.4% stake in Yancoal, because it "significantly undervalues" the stock.

Demand for thermal coal, the most polluting fossil fuel burned to generate electricity, is high due to power shortages in China and a European gas squeeze further exacerbated by Russia's invasion of Ukraine.

Yancoal confirmed it had not received an acceptable formal offer from Yankuang.

Application of automation technology in coal preparation

NTRODUCTION

With the continuous development of today's social economy, the development of coal enterprises is also very fast. Coupled with the development of various advanced science and technology and equipment, the coal preparation process has gradually developed in the direction of automation and intelligence. In the HM coal preparation process of a coal preparation plant, if the quality of the raw coal changes, the suspension process parameters will also fluctuate, which will cause a certain degree of adverse impact on the product quality. Therefore, in order to effectively solve such problems and improve production quality, the coal preparation plant reformed the overall coal preparation process and further upgraded the original automation technology to achieve further savings in energy consumption, and achieved the purpose of downsizing and increasing efficiency.

OVERVIEW OF A COAL PREPARATION PLANT

The site of a coal preparation plant was selected on the west side of Pangpangta Coal Mine Industrial Plaza, on the east side of Pangpangta Power Plant, and on the south side of the railway station, in order to use the railway line as the loading line of coal preparation plant, and it is convenient for downstream users' demand for raw coal transportation from Pangpangta power plant. Its industrial site is located in Chengzhuanggou, Yangzhai Village, Chengjiata Township, Lin County, Lvliang Area. The terrace is on the north bank of Chengzhuanggou, a tributary of the Qiushui River in Linxian County, it is on the west of Yangzhai Village, which is about 420m from east to west and 265m from north to south. The terrain of the site is flat, which is high in the east and low in the west, and the natural terrain elevation is between 1125.00-1133.00m. In this coal preparation plant, the organic components of the coal seams are mainly vitrinite, followed by the inert group, and the content of the chitin group is less; the inorganic components are mainly clay and contain a small amount of iron sulfide

OVERVIEW OF AUTOMATION TECHNOLOGY

IPC technology is also called process indirect communication technology, which can transmit signals or data between two or more processes or threads. Among them, process refers to the smallest unit of resource allocation in a computer system, and thread refers to the smallest resource scheduling unit in the computer system. Each process will have a part of its own independent system resources, which are isolated from other processes and other resources. The process indirect communication technology allows different processes to achieve resource access and coordination, so as to meet the user's demand for information resources. The application of IPC technology to the automation of the coal preparation process can realise the automatic acquisition and transmission of various mechanical equipment operating parameters, so as to promote the automatic development of the coal preparation process[1].

ANALYSIS OF RESEARCH IDEAS

Research ideas on automatic control system of a coal preparation plant

With the aid of raw coal splitting and dust test, the best raw coal separation density is determined to ensure that the measured density of qualified raw coal medium gradually approaches the given value until it is equal to the given value. Because the coal preparation process plays a decisive role in the density of qualified media in normal production, the monitoring system can control the density of qualified media by means of automatic water supplementation. Because the non-desliming and non-grading selection of the heavy-medium coal preparation process will play a decisive role in the slime content in the qualified medium in normal production.

Research ideas on density control system of dense medium cyclone

The system is divided into two parts, the first is the PID fuzzy controller, and the second is the density support decision system. The PID fuzzy control part mainly includes PLC controller, communication system and computer configuration monitoring system. In the process of this intelligent transformation, the fuzzy control algorithm was added to the original PID system to achieve a further improvement in the degree of automation of the density control of the dense medium cyclone[2]. For the density support decision-making system, in the process of intelligent transformation, the expert system is mainly used to adjust the density set value of the industrial computer according to the density data changes in the actual production process, and transfer it to the PLC controller of the next layer , In order to realise the automatic output and control of each execution parameter.

AUTOMATION TRANSFORMATION, INSTALLATION AND COMMISSIONING OF COAL PREPARATION PROCESS EQUIPMENT

Automation transformation of equipment.

In the process of this equipment automation transformation, the traditional DMAC-II automatic control system was improved and upgraded to solve the problems of large media consumption, online monitoring and parameter adjustment in the current heavy-medium washing process. The IPC plus board form in the original system is changed to IPC plus PLC form. In the discharge pipe of the qualified medium pump, 9 sets of magnetic content meters are added to detect the slime content online; 3 sets of chute sampling machines are added, and a belt is installed on the north side of the 801 belt to transport the collected heavy medium Clean coal; 3 new X-ray ash analysers are added to separately detect the ash content of heavy medium clean coal in each system; the shunt valve and series medium valve electro-hydraulic gate valve are connected to the centralised control to realise remote control of the series medium amount.

In addition, after the PLC technology is applied to the coal preparation process, the traditional manual dosing form has also realised the transformation of the automatic dosing form. The actual flow and concentration changes are used as the basis to automatically adjust the dosing amount, which is to improve the production efficiency of clean slime, it also effectively avoids slime water system problems and floating "backward channeling" problems[3].

Increase of flotation intelligent control equipment

The first is to increase the slurry ash detector, according to the on-site production situation, through the detection of concentrate, adjust the reagent system according to the ash content of the concentrate, improve the extraction rate of the concentrate, and ensure that the ash content of the concentrate does not exceed the target. This transformation adds 2 online concentrate ash content detectors, each concentrate ore slurry ash content meter alternately detects the concentrate ash content of 2 flotation machines, and the detection time is about 10 minutes. In specific applications, in order to make full use of the flotation concentrate ash detection data, the adjustment of the flotation time interval in actual production should be determined according to the actual production situation.

The second is to increase the emulsification device and quantitative dosing device of the medicament to replace the traditional manual control valve dosing; according to the feeding and product parameters, feedback the optimal medicament system for the dosing system; the medicament system is based on the input of the flotation machine real-time adjustment of parameters such as material flow and concentration.

Installation of automation technology equipment

First, add two industrial computer equipment in the centralised control room, and install DMAC-II model heavy-medium process parameter automatic control software, STEP7 V5.3 programming software and FX-V innovation form on the two industrial computer equipment for the automatic flotation reagent addition control software[4]. At the same time, the PLC programmable device was installed on the industrial computer equipment, its model is S7-300, and the PLC was programmed according to actual needs. The last is the addition of network equipment. With the help of industrial Ethernet, the heavy-medium process parameter automatic monitoring system, centralised control automatic system, and flotation reagent addition automatic control system are connected in the same network segment.

ANALYSIS OF PROCESS TEST RESULTS

After the optimisation and improvement of this coal preparation process automation, in order to identify the automatic control of heavy-medium process parameters and the actual operation of the coal preparation automatic dosing system, the coal preparation plant carried out industrial tests on the improved coal preparation process. The following is the specific coal preparation process test content after this improvement.

1. During the test, the process parameters of the intermediary system and the flotation system are collected regularly, and the specific fluctuations of related data are observed.

2. Carry out fast ash and fast float test on the middle coal separated from the three-product heavy-media cyclone to check the content of the middle coal mismatch and calculate the productivity and quantity efficiency of the clean coal.

3. Make statistics on the actual consumption of media in the heavy media system and compare it with the consumption before the upgrade.

4. Perform a fast ash test on the tailings in the flotation system to check the coal running of the tailings and calculate the productivity of flotation coal and the recovery rate of combustibles.

5. Perform statistics on the consumption of flotation reagents, mainly including statistics on the consumption of foaming agents and the consumption of collectors, and compare the statistics with the consumption before the upgrade.

The following chart is the comparison of the technical indicators of the coal preparation plant before and after the upgrading of coal preparation process automation:

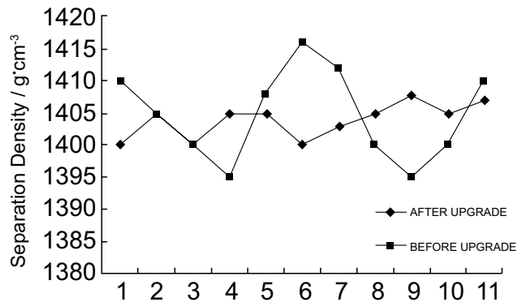


Figure 1: Comparison of the separation density of raw coal before and after the upgrade of the heavy-medium control system of the coal preparation plan.

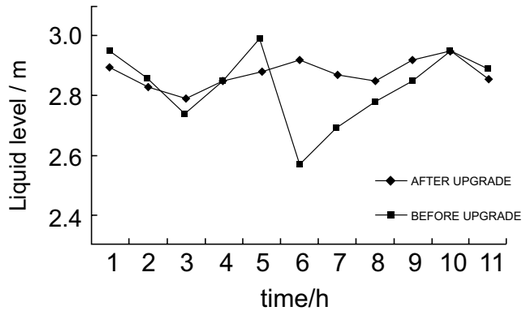


Figure 2: Comparison of the level fluctuations of qualified medium barrels before and after the upgrading of the heavy-medium control system of the coal preparation plant.

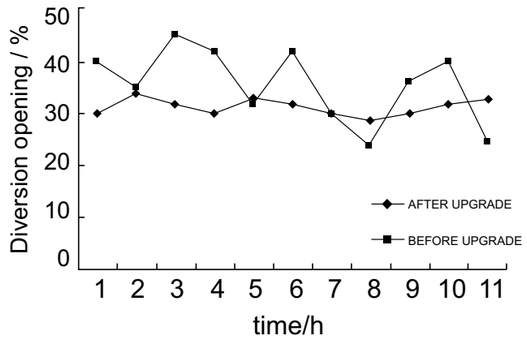


Figure 3: Comparison of the diversion opening fluctuation before and after the upgrade of the heavy medium control system of the coal preparation plant.

Table 1: Comparison of clean coal production rates before and after the upgrade of the heavy-medium control system of the coal preparation plant.

Group	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Average yield
Before upgrade	57.5%	58.1%	57.7%	58.9%	59.2%	56.7%	58.0%
After upgrade	58.9%	59.7%	59.2%	59.5%	59.1%	58.7%	59.2%

Table 2: Comparison of media consumption before and after the upgrade of the heavy-medium control system of the coal preparation plant.

Group	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Average consumption
Before upgrade	0.96kg/t	0.99kg/t	0.94kg/t	0.96kg/t	0.95kg/t	0.98kg/t	0.96kg/t
After upgrade	0.82kg/t	0.80kg/t	0.84kg/t	0.84kg/t	0.82kg/t	0.81kg/t	0.81kg/t

Table 3: Comparison of the flotation tailings before and after the upgrade of the heavy-medium control system of the coal preparation plant.

Group	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Average ash
Before upgrade	68.5%	69.8%	68.4%	68.9%	69.7%	68.2%	68.9%
After upgrade	73.8%	74.2%	74.4%	73.7%	74.9%	74.5%	74.2%

After half a year of trial operation, the effectiveness and advancement of the coal preparation process automation improvement of the coal preparation plant has been fully verified. It can be seen from the above chart that after this intelligent transformation, through the reasonable application of automation technology, which effectively reduced the content of mismatched coal in the middle coal, increased the productivity of clean coal by about 1.2%, and achieved a significant reduction in coal preparation media consumption. It can be seen that the intelligent upgrade and transformation of the coal preparation plant and the application of its automation technology have received very good results.

CONCLUSION

To sum up, in the coal preparation process of the coal preparation plant, the reasonable application of automation technology can allow the traditional coal preparation process to be optimised and upgraded, which will effectively increase the overall coal preparation process output and reduce the coal preparation media consumption, it can also make the coal preparation process more stable and reliable. This will play a good role in guaranteeing the production efficiency, production quality and production safety of the coal preparation plant, and will further enhance the economic benefits of the coal preparation plant.

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Germany weighs intervention in energy markets

Germany is considering intervening in its energy markets to bring coal plants back online and conserve natural gas as it rushes to limit further disruptions from top-supplier Russia.

Parliament on Thursday plans to vote on a regulation that would provide compensation to coal-plant operators if the supply situation deteriorates. It's part of a raft of government efforts to shore up Germany's energy security as regional tensions rise amid Russia's war in Ukraine.

"What we are doing here is leading Germany back into an energy-policy future," Economy Minister Robert Habeck said during a parliamentary hearing, calling the measure a "sharp sword."

Across Europe, governments are rushing to bolster their energy stockpiles ahead of the winter months, when demand for power and heating typically peaks. Russia has already cut gas supplies to a handful of countries and curbed flows on the Nord Stream pipeline, the biggest gas link to the continent. The pipeline goes offline for scheduled maintenance on Monday, and German authorities are concerned Moscow could use the opportunity to halt shipments for good.

The regulation would allow the government to limit generation at some gas plants if supplies of fuel are short. Worries about scarcity of supplies have contributed to a 25% jump in German power prices this week, capping a 400% rally in the past year.

Habeck said the drop in flows through Nord Stream will make it more difficult to meet a target for gas storage sites to be 90% full by November. Reserves are currently around 63% full.

Read: Germany's Habeck Urges Canada to Help Thwart Putin on Gas

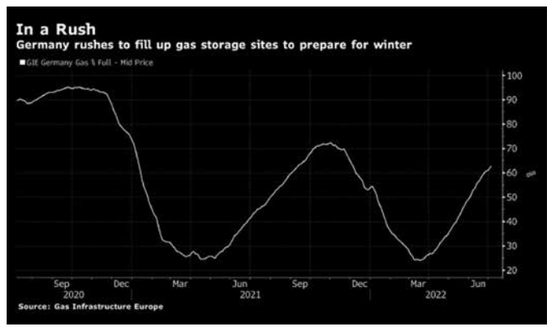
The new measure – which is part of a bigger energy framework package – will allow Germany to reopen 6.9 gigawatts of coal, 1.9 gigawatts of lignite and 1.6 gigawatts of oil capacity to boosts its energy security.

That would enable the country to cut the amount of gas used for power by 52% over the next 12 months, according to BloombergNEF estimates. Replacement of power plants will be allowed until March 2024.

"For utilities, the blow will not be as heavy since the economics of gas generation has been getting worse, and they've been making losses," said BloombergNEF analyst Kesavarthiniy Savarimuthu.

Restarting dormant coal plants could be a boon for German energy giant RWE AG, since the facilities were meant to be shut, she added. "It's a win-win situation – the government gets to reduce reliance on gas, while RWE benefits from higher margins from it's revived plants."

While replacing Russian gas is difficult for Germany – it depends on Moscow for about 35% of all gas it consumes – the country aims to become independent of Russian coal in the next couple of months. German lawmakers earlier Thursday also approved a package of reforms aimed at boosting renewable power generation.



Conveyor belt carryback

"Carryback" is defined as the material that fails to unload from a conveyor belt, adhering to the belt and typically falling off at some point other than the intended discharge, and it's one of the main sources of fugitive materials, estimated to account for 85% of all conveyor maintenance issues. Accumulation on moving components from dirty belts can cause premature wear and require frequent cleanup, which exposes workers to potential workplace injuries and respiratory diseases.

It can be shown practically and theoretically that a conveyor belt cannot be cleaned 100%, because the surface of the belt and the blades are not without imperfections. However, this doesn't mean operators shouldn't take a proactive approach to keeping the belt clean. Most industries have gravitated to basic mechanical scraping with a metal or elastomeric blade for flat rubber or PVC belting as the best combination of effectiveness, ease of maintenance and low belt wear to yield the lowest cost of ownership.

BELT CLEANERS

Belt cleaning effectiveness varies day to day with changing conditions and the number and type of cleaners applied, as well as the maintenance they receive. Keeping the material in the process is always better than letting it accumulate on components and build up under the conveyor. Without effective belt cleaning, experience has shown that as much as 3% of the total cargo can be lost due to spillage, dust and carryback.

The exposure to hazards and injuries is also reduced when less cleanup is required, saving significant – but seldom considered – indirect costs. The key to consistent cleaning effectiveness is to control the process through proper selection, installation, inspection and maintenance of the belt cleaning system and establish a safe cleanup routine and schedule.

The use of multiple mechanical scrapers on a belt has been accepted for quite some time as an effective cleaning approach. In most operations, multiple cleaners are required to reduce the carryback to a safe, acceptable level while limiting manual cleanup to weekly or even monthly tasks.

EFFECTIVENESS VS. EFFICIENCY

The undulating action of the loaded belt passing over idlers tends to cause fines and moisture to migrate and compact on the surface of the belt. The amount of carryback that clings to the belt can range from a few grams to a few kilograms per square meter. The level of belt cleaning required is a function of the operational schedule and method of collecting / disposing of the carryback that is cleaned from the belt or dislodged by return idlers and collects outside of the conveyor discharge chute.

When discussing the efficiency of a belt cleaner, it's meaningless to talk about efficiency without stating the initial level of carryback. When considering the beginning and ending levels of carryback as a measure of improvement, effectiveness is a better term. Some guidelines do exist. The U.S. Bureau of Mines states that an average of 100 g/m2 of carryback is a reasonable level of performance for belt cleaning. At this level, a 1200 mm (48-inch) wide belt traveling 2 m/s and operating 24/7 would create a cleanup workload of about 7 tons per day, a significant labor investment that also increases worker exposure to a moving conveyor and the associated risks.

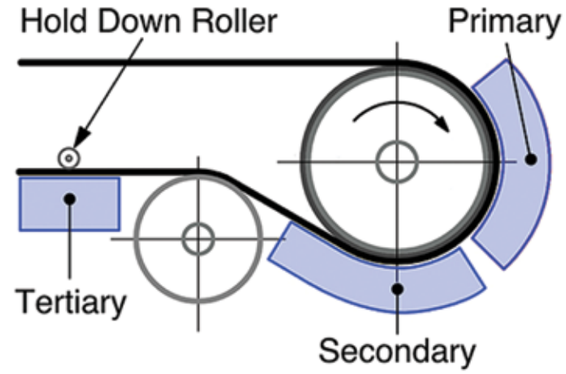
Carryback level determines the cleanup schedule, but in reality, a typical belt cleaner loses effectiveness over time due to wear, lack of inspection and maintenance. On systems with average or poor maintenance, effectiveness values are generally in the range of 40-60%, thus the need for multiple cleaners.

CLEANING LOCATION

Unfortunately, designers often focus on the lowest installed cost of the structure around the head and snub pulleys, without allowing enough space for optimum cleaner installation. The figure below shows the clear areas needed on a discharge chute for installation of belt cleaners in the optimum positions. The installations should be at an ergonomic height above the work platform to encourage proper inspection and service. Consideration in the design stage for locating cleaners in the optimum locations will lead to more effective inspections, maintenance and belt cleaner performance.

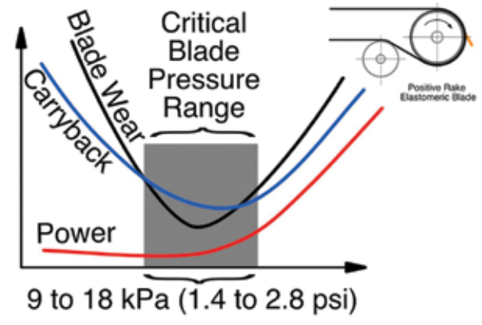
Belt cleaners can be placed anywhere along the return run of the belt, as long as the belt is supported in some fashion. Since it's desirable for the carryback cleaned from the belt to be returned to the main material flow, most belt cleaners are installed inside the discharge chute. Cleaning on the head pulley – labeled the 'primary cleaning position' – is preferred. Cleaning the dirty side of the belt before it reaches a snub, bend pulley or return idlers is considered less desirable, requiring a dribble chute for cleaners in the secondary position.

The secondary position is complicated by another fact: the nature of carryback is such that it can adhere to vertical surfaces and not flow down a sloped dribble chute. A tertiary position is sometimes required for difficult materials or

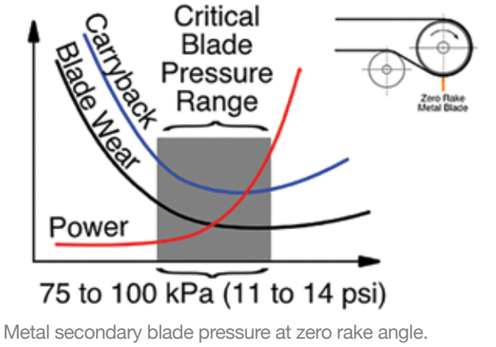


Belt cleaning positions.

Typical installation of primary, secondary and tertiary cleaners.



Elastomeric primary blade pressure at a positive rake angle.



Metal secondary blade pressure at zero rake angle.

Automatic tensioner maintains optimum cleaning pressure without operator intervention.

critical applications such as conveying over wetlands. In such cases, the tertiary cleaners are often enclosed in a spray box and the effluent directed to a settling basin.

BELT CLEANING PRESSURE & BLADE WEAR

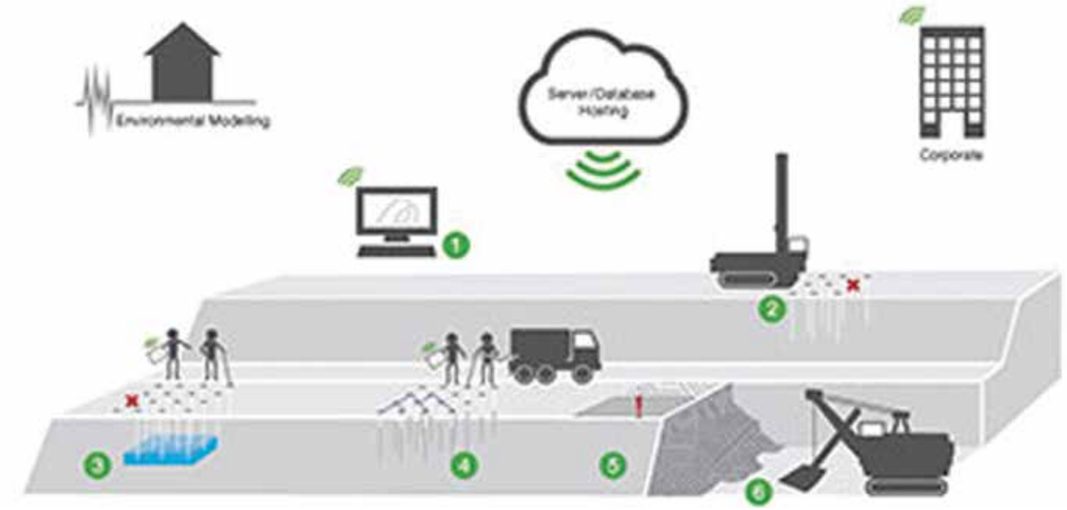
Without enough cleaning pressure, the blade cannot stay in contact with the belt, resulting in poor carryback removal effectiveness and increased blade and belt wear. With too much cleaning pressure, the cleaning performance declines due to deflection of the elastomeric blade or metal blade indentation into the rubber belt. Power consumption also increases dramatically with excessive cleaning pressure.

Keeping a belt cleaner properly tensioned is critical for maximum effectiveness and lowest cost of ownership. The cleaning pressure usually varies over time, based on the maintenance department's attention or lack thereof. Some manufacturers have begun to offer automatic tensioners and wear indicators which maintain the optimum cleaning pressure and alert operators when blades are worn.

FINAL THOUGHTS

Many belt cleaner systems are installed and forgotten. A survey of technicians indicated that about 25% of all belts have cleaners installed, and of that percentage only about 25% are properly maintained. Lack of inspection and maintenance results in a gradually lower level of effectiveness, higher operating cost and an increased exposure to the hazards associated with cleaning up carryback.

Effective belt cleaning starts in the design stage, with adequate space for cleaners and well-positioned work platforms for ergonomic inspection and maintenance access. Service-friendly designs improve production, minimising carryback and prolonging the life of equipment. If the cleaners are located in the optimum positions and easy to access, it is more likely that regular inspection, cleaning and maintenance will be performed, delivering optimum results.



Modern mine planning software

Modern mine planning software plays a crucial role in the operation of many of the world's mining operations and projects. Mine planning software provides the mining industry with a fast, accurate, cost effective and efficient tool in order to manage their business interests worldwide. Every aspect of the mining industry is today using some form of mine planning software. From exploration to rehabilitation, the use of software is becoming more and more widespread.

Mine planning software companies are constantly under pressure to evolve products to meet new challenges and solve new problems. Development of software is a result of both programming foresight and reaction to industry demands. Without mining industry feedback, many of the products now available would probably not have been developed. Mining software is an extremely competitive market which constantly drives the levels of development to new heights. This paper discusses some of the most important new tools and technologies incorporated in modern mine planning software and presents potential areas of improvement and further development.

MODERN PACKAGES

There are several software products on the market today covering a large range of capabilities. Many packages are aimed at one market, such as database management and surveying. Others concentrate on CAD functionality. However, over the past couple of decades, several software packages have evolved to carry out most of the functionality required on an operation or project. The standard functionality carried out by these packages includes:

- Visualisation
- Modelling
- Database Management
- Reserve Calculation
- Mine Design
- Mine Planning

The development of mine planning software has gone through many changes in hardware compatibility, software tools and users expectations. These changes have impacted on management decisions as to the most cost-effective approach to providing the users the applications they need. The major objective remained the same throughout this development: to provide users with tools that allow quick and accurate management and assessment of the value and risk associated with the exploration, feasibility, and production of mineral resources. With the increasing range and sophistication of the applications, the development and management of the software requires a greater level of coordination than the simpler non-integrated systems of some decades ago. Professional development of the software by dedicated teams of software engineers is essential to the production of software that satisfies users' expectations.

WHAT IS THE BEST SOFTWARE FOR MINING?

There is an array of software out in the market, and it is impossible to endorse any one company as at the end of the day it becomes the decision of the engineers as to which package suits their operation although the most commonly used software packages in geological modelling for coal are MineScape and Minex. Some add Surpac to the mix to calculate the reserves and conduct mine planning and scheduling of mining activities. Here is a brief summary of what the companies offer.

MINESCAPE

Specifically developed to meet the mining industry's rigorous demands, MineScape is used at more than 200 of the world's most complex mining operations from nickel phosphate mining in Russia to coal mining in Indonesia. MineScape 2021 is a suite of integrated solutions designed for open cut and underground mining operations for coal and metalliferous deposits. It delivers extensive geological modelling and mine design functionality, making it a leading mine planning solution globally.

Incorporating many features, MineScape offers exceptional ease-of-use through:

- Intuitive Microsoft-like familiar working environment
- True simultaneous multi-user access to all 3D data and models
- Quick designs with advanced Rapid 3D CAD capabilities
- Simple data management with MineScape Explorer to browse projects and manipulate data
- Accurate complex stratigraphic modelling functionality including reverse faulting
- Accurate interpolation through surface-following estimation for block model
- Data integrity through integration of the geological database with modelling and the 3D graphics environment
- Volume and reserves calculation in customised MS Excel format
- Rapid surface design functionality available within the Surface Engineering product
- Longwall layout and conventional pillar design completed quickly using the Underground Engineering product

MineScape is a geological modelling and mine planning solution within Datamine's suite of mining software.

MINEMAX

Minemax Planner's simple, guided workflow enables operations to rapidly:

- Understand the potential value of projects
- Tackle pit optimisation for ultra-large datasets
- Incorporate multiple elements and processes
- Optimise pit shells and minable pushbacks
- Develop a high-level strategic schedule
- Analyse risk analysis, including financial/grade uncertainty
- See how prices, recoveries, costs and grades affect KPIs/NPV.

Extremely easy-to-use interface with step-by-step workflows and reduces the setup time of projects and it's easy to use even for first time planners.

SURPAC

GEOVIA Surpac™ claims to be the world's most popular geology and mine planning software, supporting open pit and underground operations and exploration projects in more than 120 countries. The software delivers efficiency and accuracy through ease-of-use, powerful 3D graphics and workflow automation that can be aligned to company-specific processes and data flows. Surpac addresses all the requirements of geologists, surveyors, and mining engineers in the resource sector and is flexible enough to be suitable for every commodity, orebody and mining method. Its multilingual capabilities allow global companies to support a common solution across their operations.

Benefits

- Comprehensive tools include: drillhole data management, geological modelling, block modelling, geostatistics, mine design, mine planning, resource estimation, and more.
- Modular and easily customised to adapt to changing needs.
- Ability to seamlessly share data, skills and project knowledge across teams and departments.
- Increased time savings with compliance to company-specific processes.
- Consistency of execution using task automation.
- Reduced data duplication with file format support of popular GIS and CAD systems.
- Integrated production scheduling with GEOVIA MineSched™.
- Multilingual support: English, Chinese, Russian, Spanish and French.

CONSULTANTS

According to SRK Consulting a global leader in the industry, the engineer employs the software systems that are most in demand in the industry. Historically, geological modelling and mine design and planning have been packaged together, while scheduling, reporting, and costing were often done using spreadsheets or a separate package. Many packages attempted to bridge this division, but due to their inability to effectively meet the requirements of mining operations, no clear leader has emerged in scheduling software. However, as scheduling software developers delve into mine design, while modelling companies increase their scheduling capabilities and expertise, the playing field levels out.

Mining consultants play an important role in the choice of software to use and are a good endorsement for software developers although many develop the software in house.

The typical requirements for planning and scheduling a mine include:

1. The Resource and Geological Model as a starting point for engineering design and planning work. It is a geologist's interpretation of drill hole information and allows the engineer to visualise and suitably design access to the ore and decide on the methodology to extract it. In particular, SRK's in-house expertise can provide 3D geological models on nearly every computer system used around the world.

2. The Engineering Model is the key component in the planning and scheduling process. It uses engineering parameters to determine the extent of the deposit and assess the mineable quantities and qualities of ore. It provides the practical, mineable interpretation of the geological model.

3. The Scheduling Model is the tool used to determine the rate, quantity, and sustainability of the engineering model. Adding this "time" component allows the engineer to calculate what practical production can be generated and maintained over the course of the mine's life. It pinpoints periods of stress, where parameters may need to be modified to continue effective operations and alerts the engineer to adjust designs and plans to accommodate deficiencies in mine production before they become operational or contractual problems.

Romanian government passes emergency ordinance on decarbonisation of Romania's energy sector

The government will be allowed to postpone the closure of some coal-fired energy facilities and related mining and quarrying operations or restart closed energy facilities and related mining and quarrying operations in the event of an energy crisis, according to an emergency ordinance passed recently.

"In an energy crisis, the Romanian government, at the proposal of the Ministry of Energy, may take a decision to postpone the closure of coal-fired energy facilities and related mining and quarrying operations or to restart closed energy facilities and related mining and quarrying operations in compliance with the environmental legislation and the deadline for completing the decarbonisation of the energy sector and in correlation with the measures included in the emergency plans related to the energy sector," the Ministry of Energy reported.

In order to bridge the capacity deficit created by the elimination of coal from the energy mix, investments are made for the commissioning by 2030 of new hydroelectric production facilities and nuclear energy facilities.

At the proposal of the Ministry of Energy, the government passed an emergency ordinance on decarbonisation of Romania's energy sector, a milestone in the National Recovery and Resilience Plan (PNRR), given that the phased elimination of lignite and coal-fired power plants is part of Component C6. Energy, Pillar I. The green transition under the National Recovery and Resilience Plan.

The bill establishes the general legal framework for the phased elimination from the energy mix of electricity production based on lignite and coal, deadlines for closing and conserving energy facilities operating on lignite and coal and measures including securing the reserves for a safe and stable operation of the National Electric Power Grid.

The mines and quarries will be withdrawn from operation and preserved in conjunction with the commissioning of investments in natural gas and renewable energy.

At the quarries where the mining activity of lignite mining ceases, permanent closure and greening works will be carried out, considering the fact that the lignite mining activity had an impact on the environmental components, with the soil being the most affected. Also, closed coal mines can be included in the tourist circuit, in compliance with the legal provisions in force regarding the safety and security of visitors.

The ordinance also establishes a series of social protection measures, as well as measures for professional retraining.

In eastern Ukraine's coal fields, Russia's invasion sparks hopes of a comeback

A little more than 4 miles into a mine, in the newfound relative comfort of being over 1,000 feet underground, eastern Ukrainian coal miners position a drill bit on a dark rock wall.

A series of beeps echoes in the dimly lit tunnel, hydraulics hum and the spiked spherical bit spins into a blur before it brushes the wall, filling the cavern with a cloud of thick, muting dust.

This is Ukraine's "energy front line," says Aliona Samarska, an employee of the privately owned coal mine. NPR is not using the mine's name or location for security reasons. Despite mining's own familiar dangers, Samarska says many miners say they feel safer underground. And this front line could be just as critical to the war effort, Ukrainian officials say, as the artillery-lined trenches being dug into the country's surface.

Russia's invasion of Ukraine has become a brutal war of attrition that Western military analysts warn could last for months or years. While Ukraine focuses on immediate needs like stalling Russia's slow advance in the east and finding export routes for spoiling grain, there are also growing concerns about the coming winter – the next heating season – when the tens of millions of Ukrainians who are still in the country will need electricity to warm their homes.

"This will indeed be the most difficult winter of all the years of independence," Ukrainian President Volodymyr Zelenskyy recently warned in a video address.

It's a heating season Russian President Vladimir Putin is looking to weaponize, says German Galushchenko, Ukraine's energy minister. He says Russian forces have repeatedly targeted energy infrastructure in the more than four months since they launched a full-scale invasion. "If we are talking about the long-term war, it makes sense they should target this because they know that we are preparing for the next heating season," he says.

Oil and gas pipelines have been shut off or destroyed. Imports from Russia and Belarus have been stopped. Fuel shortages in the country are already stymieing travel.

To alleviate the coming crunch, Ukrainian authorities have put a pause on all oil, coal and gas exports from the country. Energy sources are being reserved for domestic use. And there are talks of expanding coal extraction, where possible, to meet the coming demand. That's despite prewar efforts to decarbonize the country's economy to reduce harmful gas emissions that cause climate change.

"In the long-term of course we should follow this green course and the Paris agreement and all of this," Galushchenko says.

But right now, he says, "our general strategy is to provide Ukraine with the necessary energy resources it needs."

Miners in eastern Ukraine, who have long watched their industry erode, see the shift in rhetoric and renewed focus on coal as an opportunity.

Leading Western economies have vowed to move away from Russian energy and are hitting Moscow with hefty sanctions over its invasion of Ukraine.

An employee at a coal mine in eastern Ukraine travels deep into the mine.

Workers wait to get off an elevator at a coal mine in eastern Ukraine.

A closed coal mine in eastern Ukraine sports a Soviet star painted in Ukrainian colors. Many unprofitable mines have been shuttered or privatised.

"I believe that the demand for coal in the whole world will increase," says Oleksander Aksonov, the lead engineer of this mine in eastern Ukraine, as he stands in the harsh light of a headlamp at the end of a tunnel. "Due to the sanctions [on Russia], the import of oil is limited now so coal will be in high demand."

Ukraine invasion – explained

Shredded trees, dead dolphins and wildfires – how Russia's invasion is hurting nature

He adds, "Providing Ukraine with power is on our shoulders now."

Global coal production is on the rise.

The burning of coal, a carbon-rich fossil fuel, is the single largest source of climate-warming emissions in the world. Scientists and world leaders have pledged to phase it out, "consigning coal to history," but even before Russia's invasion, the global demand for coal was rising.

Spurred by surging electricity use following pandemic lockdowns and limited supplies of natural gas, coal production and pollution jumped sharply in 2021. Then came Russia's invasion and the European Union's ban on most Russian oil imports.

Russia was the world's largest exporter of fossil fuels in 2021, according to the International Energy Agency. Many of those exports went to Europe. And there are concerns Russia may be looking to use that dependence to gain "leverage" in international talks as winter draws nearer, Fatih Birol, the head of the IEA, told the *Financial Times* in June.

To brace themselves for the winter ahead, European countries, including Germany, Poland, Italy and the Netherlands, have announced plans to resurrect old coal plants. Britain recently announced it may keep some coal plants, slated for closure later this year, open longer.

Ukraine invasion – explained

The once-quiet southwestern corner of Ukraine is now playing a key role in trade.

In Ukraine, which has the sixth-largest coal reserves in the world, the situation is complicated by Russian forces' repeated attacks on its rail infrastructure; the fact that they occupy a Ukrainian nuclear power plant – Europe's largest; and their territorial gains in the country's coal-rich east.

Ninety percent of Ukraine's coal is believed to be in the Donets coal basin – the Donbas – where slag heaps dot the pancake-flat landscape like little mountains and elevator towers, reaching skyward, are still sometimes adorned with the Soviet star.

Prior to the outbreak of armed fighting in 2014, there were 227 coal mines in eastern Ukraine, according to a report by the Organisation for Security and Cooperation in Europe, an intergovernmental organisation. More than 80% of them have since fallen under Russian occupation.

"Mines are the most important thing here," says Aleksandr, a 62-year-old retired miner in Dobropillia, a town in the Donetsk Oblast. He asks not to use his last name because of Russia's recent military advances in the area.

His apartment building sits next to a massive mound of slag and a mine where operations briefly stopped in April. He doesn't flinch as an air raid siren starts to blare.

"If we stop producing coal," he says, "these towns will die."

"The climate crisis and this

Workers having just gotten off the elevator head deeper into the mine to start their shifts.

An operator of the mine railway that carries people in and out of the depths of the mine waits as workers disembark.

A slag heap rises behind residential buildings in Dobropillia, a town in the Donbas. Ninety percent of the country's coal is believed to be in the Donets coal basin in the Donbas region.

Mine workers are surrounded by dust as a drill bit chews into the wall of the mine.

A chapel for workers in the mine's compound in eastern Ukraine.

Signs of workers rise above the grounds of a coal mine in eastern Ukraine.

A mine employee folds his hands as he sits in the mine railway awaiting his stop. For miners in eastern Ukraine, who have long watched their industry erode, the shift in rhetoric and renewed focus on coal is being seen as an opportunity.

Valerie Ivaniv stands at a bus station in Pokrovsk, near the front lines and the Russian-backed separatist Donetsk region, where he waits for a bus to pick him up for a 12-hour shift at the mine.

war have the same roots"

Despite its history and regional importance, Ukraine's coal industry has been on a similar decline to coal mining in the United States.

Total Ukrainian production dropped from a 174 million tons in 1986 to a record low of 24 million tons in 2020, according to the London-based data analysis firm CEIC Data.

Unprofitable mines have been shuttered or privatised. Pay for miners has been cut. Efforts were underway before the most recent invasion to help transition Ukrainian coal communities away from the heavy polluting industry and to keep towns alive.

"Not long before the war we had the concept of a just transition being approved on the state level," says Iryna Holovko, a board member at the Center for Environmental Initiatives Ecoaction, a Kyiv-based nonprofit. "And now the priority is on internal extraction, which is absolute nonsense."

During last year's international climate conference in Glasgow, Scotland, Ukraine promised to stop burning coal by the year 2035, shifting instead to nuclear, renewable energy sources and natural gas.

Holovko is worried that Russia's invasion and Ukraine's immediate response put that in doubt, and that new investments in Ukrainian fossil fuel resources will give them a longer life.

"The war has shown the risks connected with fossil fuels, which are actually powering Putin's war machine," she says. "The climate crisis and this war have the same roots."

Ukraine's Energy Ministry says it will continue to pursue green energy sources. Galushchenko, the energy minister, says an agreement has already been made with the U.S.-based Westinghouse Electric Company to build new nuclear plants in Ukraine as soon as the fighting stops.

In the immediate-term though, Ukrainian mines are expected to play an increased role in providing thermal and steel-making coal, much of which was imported prior to Russia's invasion.

At a bus station in Pokrovsk, near the front lines and the Russian-backed separatist Donetsk region, a crowd of coal miners smoke cigarettes and wait for a bus to pick them up for a 12-hour shift.

Valerie Ivaniv checks his phone.

"It's really scary to go to the mine because you don't know what's going to happen with your family," he says. "I feel safer. I work [almost 4,000 feet] underground. But there's no mobile communication. That's why you worry for people on the surface."

The work is grueling, he says. Temperatures at the bottom of the mine are often around 120 degrees Fahrenheit.

But the coal they extract, he says, "is the best in the world." It's metallurgical coal – coking coal, critical for the production of steel. And steel will be needed in Ukraine, Ivaniv says, to rebuild.

Joy Compak Next Gen hydraulic control system helps improve performance of high production longwall systems

High-performance valve technology helps improve cycle times by up to 12%*

When mining in challenging, unpredictable conditions, operators need confidence in their longwall systems, and building that confidence starts with the hydraulic functions in powered roof supports (PRS). Improve the performance of your high production longwall systems by equipping your PRS with the multifunctional Joy Compak Next Gen hydraulic control system, and help facilitate your shearer cutting rate with exceptional cycle time performance.

Engineered to be durable and reliable in rugged environments, the Joy Compak system features corrosion-resistant materials on valve block assemblies, components and the main body. With a reduced number of components to lessen wear and tear, the spool valve in the system is engineered to handle higher flow rates, to help reduce the risk of part failure and promote extended life. Providing flexibility to suit the individual needs of your operation, the Joy Compak Next Gen hydraulic system can be conveniently upgraded or retrofit to any PRS system (regardless of manufacturer).

Increase productivity

The high-performance valve technology of the Compak hydraulic control system helps improve cycle times by up to 12%, compared to the previous model. Designed with operators in mind, this hydraulic system's overall size is reduced by up to 27%** and weight by up to 30%**, making it easier to position, while improving accessibility. Hosing position has also been conveniently located for better access.

The reliable hydraulic valve system helps control modern automated longwall powered roof supports from the Faceboss electronic control system using solenoid control or through manual control with the solenoid push button override function. Ergonomically positioned for ease of access, operators can control the main override function easily and effectively through an integrated pushbutton within the solenoid.

High reliability

Seals play a crucial role in the functionality of the hydraulic spools that operate your roof supports' functions, and Komatsu's innovative and proven seal technology helps prevent leakage in your hydraulic spools. A simplified, standardised hydraulic circuit design helps provide a reduction in the number of spool valves without impacting performance of the Compak hydraulic system. This design minimises fitting and connecting hoses, to help reduce potential leak points.

Easily expand the system (over 16 functions) to increase functional requirements to suit your operation's needs. For example, a standard 10-spool valve can be expanded with ease through separate two- and four-spool expansion modules.

Modular approach streamlines maintenance

To help reduce lead times for replacement parts and streamline maintenance, the hydraulic control system features a modular design incorporating a series of standard components. Easy to change cartridge-style construction makes replacement straightforward and manageable. Manifolds, valve assemblies, cartridge valves and fittings are all standard as part of the system's modular design. The modular approach also makes upgrades easy.

*Comparison based on previous model
**Comparison based on previous model (like-for-like designs) without extra add-ons

Bowen completes New Lenton acquisition

Bowen Coking Coal has completed the acquisition of New Lenton Coal, which currently owns a 90% interest in the Lenton Joint Venture.

The JV, originally announced in August 2021, represents a transformational acquisition for Bowen. It features the Burton Mine and Lenton Project as well as the existing Burton plant and infrastructure, which is strategically located in close proximity to existing Bowen assets in Queensland and will have total processing capacity of up to 5 m tonnes pa.

The transaction materially enhances the scale and diversity of Bowen's portfolio of coal assets and provides the company with a unique opportunity to establish a new processing hub in the Burton Complex.

The company has already completed the refurbishment of the kitchen and first rooms of the accommodation village, being a critical asset to support the refurbishing crews and mining contractors to reduce long travel times from existing accommodation facilities in the region.

Long lead items have been ordered and project teams assembled for the refurbishment of the coal handling and processing plant.

Bowen executive chairman Nick Jorss said the milestone continued its emergence as the next significant mining company in the Bowen Basin.

"The Burton mine has a proven track record and has produced a coking coal brand that is known for its high quality, low ash and low sulphur," he said.

"In conjunction with the recent $190 m financing announcement, we look forward to bringing the Burton brand back to the seaborne market as we play our part in supplying this critical mineral into the steel industry."

A step-by-step procedure for tests and assessment of the automatic operation of a powered roof support

A powered longwall mining system comprises three basic machines: a shearer, a scraper (longwall) conveyor, and a powered roof support. The powered roof support as a component of a longwall complex has two functions. It protects the working from roof rocks that fall to the area where the machines and people work and transports the machines and devices in the longwall as the mining operation proceeds further into the seam by means of hydraulic actuators that are adequately connected to the powered support. The actuators are controlled by a hydraulic or electro-hydraulic system. The tests and analyses presented in the developed procedure are oriented towards the possibility of introducing automatic control, without the participation of an operator. This is important for the exploitation of seams that are deposited at great depths. The primary objective was to develop a comprehensive methodology for testing and evaluating the possibility of using the system under operating conditions. The conclusions based on the analysis presented are a valuable source of information for the designers in terms of increasing the efficiency of the operation of the system and improving occupational safety. The authors have proposed a procedure for testing and evaluation to introduce an automatic control system into the operating conditions. The procedure combines four areas. Tests and analyses were carried out in order to determine the extent to which the system could be potentially used in the future. The presented solution includes certification and executive documentation.

INTRODUCTION

The development of the underground coal mining industry is boosted by the need to improve the efficiency of the mining process, at the same time, maintaining the required level of safety and protecting the environment. Machines and devices with innovative designs that automate the process of mining are the key elements required to improve the mining process. One of the basic directions of development in the world mining industry is the automation of a longwall unit. Today, manufactured longwall shearers have improved mining efficiency with a face feed speed of almost 10 m/min. This means that the sections of the powered roof support must be moved within a maximum of 9 s for sections that are 1.5 m wide, and 10.5 s for sections with a width of 1.75 m. It is not possible to obtain such performance parameters using traditional, manual control of the powered roof support. These requirements and the fact that the design of a support section is complex means that a hydraulic system needs partial or full automation to achieve large hydraulic fluid flows[1-6]. The automation process reduces the total number of operators controlling the support sections and makes it possible to remove them from the immediate vicinity of the support that is being moved. This has a positive effect on safety by removing personnel from the active face.

The procedure developed based on research and analysis includes four stages. These are essential for manufacturers of longwall roof supports and producers of control systems, as it accurately and easily shows what the sequence of design, research, and production work should be. From a scientific point of view, the third stage is the most important one, as the results obtained, either positive or negative, make it possible to analyse whether the assumptions made in Stage 1 coincide with the design made in Stage 2. As a result of the research on prototypes and the acceptance of prototype modifications, documentation is developed, as presented in Stage 4. The procedure takes into account all possible safety requirements and the possibility of effective preparation of automatic control. The nature of the presented concept is open, as it takes into account the possibility of introducing specific conditions in which the seam will be mined, and the selection system used. The procedure can be modified to fit the research and development of automatic control devices and future requirements.

The depth of underground hard coal mining has been constantly increasing in the past years. This, in turn, increases natural hazards such as exogenous fire, seismicity, and methane hazards[7,8]. The longwall system in terms of these hazards challenges manufacturers, researchers, and mining companies to ensure an appropriate level of occupational safety. Currently, a considerable involvement of researchers in solving problems related to methane hazards[8-15], endogenous fires[7], and seismicity[16] can be observed worldwide. Therefore, global coal mining is at the forefront of the desired energy resource alongside oil and gas[17-19]. Coal mining in an underground mine is carried out using a longwall system that uses such machines as a shearer that mines the coal, a scraper conveyor for haulage, and a powered roof support for the longwall system. They operate together and form a longwall complex (**Figure 1**).

Monitoring the machinery and equipment in the longwall complex and mining and geological conditions largely contributes to the maintenance of sustainable development of mining in the world and improvement of work safety[20,21,22,23,24,25,26,27,28]. Recently, there has been extensive activity in the development of research on the application of new technologies in mining thanks to Industry 4.0[29-32]. The selection of technical parameters of machines and equipment is important due to the arduous conditions in which they will work. It is possible to evaluate correctly selected machines through active monitoring of their operating parameters and analysis of operating conditions [33,34,35,36,37,38,39]. One of the main sources of hazards causing accidents at work in mining plants is the technical

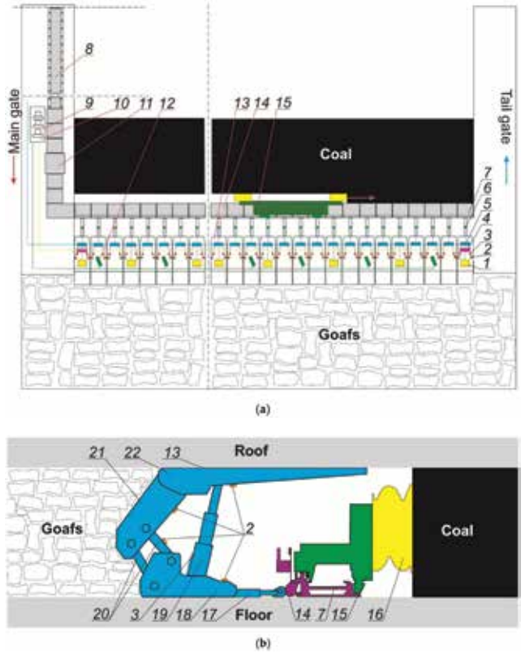


Figure 1: Arrangement of machines and equipment in a longwall complex: (a) cross-section of the longwall and (b) longitudinal section of the longwall, where 1 – power supply, 2 – inclinometer, 3 – pressure sensor, 4 – central controller, 5 – controller with an executive block, 6 – route sensor, 7 – longwall scraper conveyor, 8 – belt conveyor, 9 – shearer control station with closed circuit television, Closed Circuit Television (CCTV) monitors and monitoring of operating parameters of the powered roof support, 10 – scraper conveyor, 11 – crusher, 12 – CCTV camera, 13 – powered roof support, 14 – sliding system connection with a scraper conveyor, 15 – shearer, 16 – cutting unit, 17 – sliding system, 18 – floor base, 19 – hydraulic leg, 20 – lemniscate system, 21 – shear support, and 22 – roof.

infrastructure and, in particular, machinery and technical equipment. In 2019, the rate of accident and mortality associated with technical hazards caused by machines and equipment was approximately 50% of all events[40]. To ensure safe use and proper hazard assessment, machine and control equipment designers place the greatest emphasis on structural safety aspects. The related requirements are defined in standards[41-46] harmonised with the Machinery Directive[47]. However, due to technical progress, such standards do not exist for most of the machine control systems currently developed. Therefore, in order to ensure compliance with the essential requirements of the Directive, a package of technical standards on functional safety issues was created; it includes the concept of safety assessment of machinery[41,43].

The mining and geological conditions in which the powered roof support system is to be used can be divided into dynamic impacts of the rock mass on the longwall excavation where the roof support system works. This phenomenon is more dangerous than mining and geological conditions in which the rock mass does not tend to tremble. Sudden clamping of

the excavation means a static displacement that overloads the longwall complex that is supposed to be supported by the powered roof support. The load that impacts powered roof supports results from the movement of rock masses at a certain speed. The main task of powered longwall supports is to transfer loads resulting from changing mining and geological conditions, allowing for deformation of the longwall excavation to a minimum degree[48].

The powered roof support is a hydraulic machine powered by high pressure with an oil-water concentrate as an energy carrier. Spragging of the support section of the powered support for the required height of the excavation and its support is conducted by hydraulic legs. They constitute a structural connection between the canopy and floor base. As a result of the impact of the rock mass, the hydraulic legs carry the load depending on the conditions under which the powered support operates. Their protection is ensured by placing a safety valve in the hydraulic system[49]. It is vital to carry out an economic analysis of the effective protection of the powered roof support together with all machines of the longwall complex. In the past, several studies on the automation of the entire mining process were conducted[50-54]. The selection of a safety valve for the hydraulic system of the leg of the powered roof support working in the conditions where tremors often occur is key as it affects the safety of machines and people[55,56].

MATERIALS AND METHODS

Coal mining in an underground mine is based on a longwall complex that uses the powered roof support. In most cases, a hydraulic system based on manual controls is used to control the roof support. This is mainly determined by the economic efficiency of the company. It is reasonable to work towards reducing the number of workers near working machines to improve work safety. It is also important to measure the number of failures of machines and equipment carrying out technological processes related to hard coal mining.

The development of longwall complex automation technology in recent years has been directed towards the identification of shearer operation parameters based on the monitoring. A device that plays a crucial role here is a sensor that is applied in various systems designed to monitor the parameters of a longwall complex[57-59]. It is intended to improve occupational safety. With the development of intelligent computing technologies, it has become possible to develop intelligent algorithms related to neural networks, fuzzy logic, hybrid methods[58-77]. This formed the foundation for the development of an automatic control system for a powered roof support in a longwall complex.

System Design and Development

The powered roof support section, with hydraulic legs as its main elements, directly affects the required protection of the excavation. Vital functions are performed by other hydraulic cylinders including advancint the armoured face conveyor and in the powered roof support, such as the conveyor slide or the support of the canopy. Monitoring the pressure in the legs and determining the geometry of the section position in the excavation is an essential factor in the exploitation of longwall complexes. The possibility of automating specific sequences of work of particular elements of the support and controlling their implementation allows limiting the presence of the miners in the excavation. Equally important is the fact that the section of the roof support is guided by the profile of the excavation by means of appropriate cooperation of the section of the roof support with a scraper conveyor. Based on the presented concept, a vision of the system was designed together with a visualisation of the operating parameters, which is shown in **Figure 2**. A diagram of the actual control system of the powered system as a test demonstrator is shown in **Figure 3**.

The Requirements for the Design Procedure

The concept of the software and database structure was based on the assumptions of the analysis of the control system operation possibilities. A special criterion is to determine the areas which will constitute a visualisation of the working parameters. The information gathered in the database will be used to report on the production process of coal mining. The concept for the development of computer software architecture is based on the research

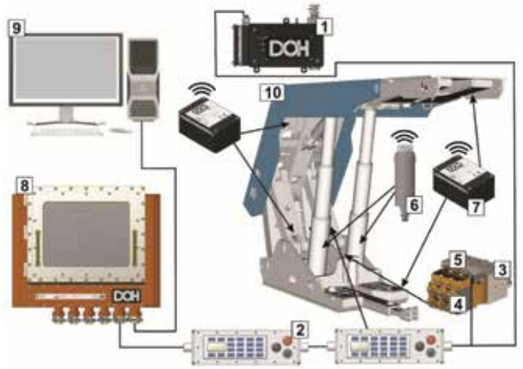


Figure 2: The concept of the devices that are part of the system; 1 – intrinsically safe power supply, 2 – controller, 3 – electro-hydraulic executive block with control inserts, 4 – solenoid valve, 5 – control bar, 6 – pressure sensor, 7 – inclinometer, 8 – underground computer, 9 – surface computer, and 10 – powered roof support section.

Figure 3: Prototype devices that are part of the system; 1 – intrinsically safe power supply, 2 – controller, 3 – electro-hydraulic executive block with control inserts, 4 – solenoid valve, 5 – control bar, 6 – pressure sensor, 7 – inclinometer, 8 – underground computer, 9 – surface computer, and 10 – powered roof support section.

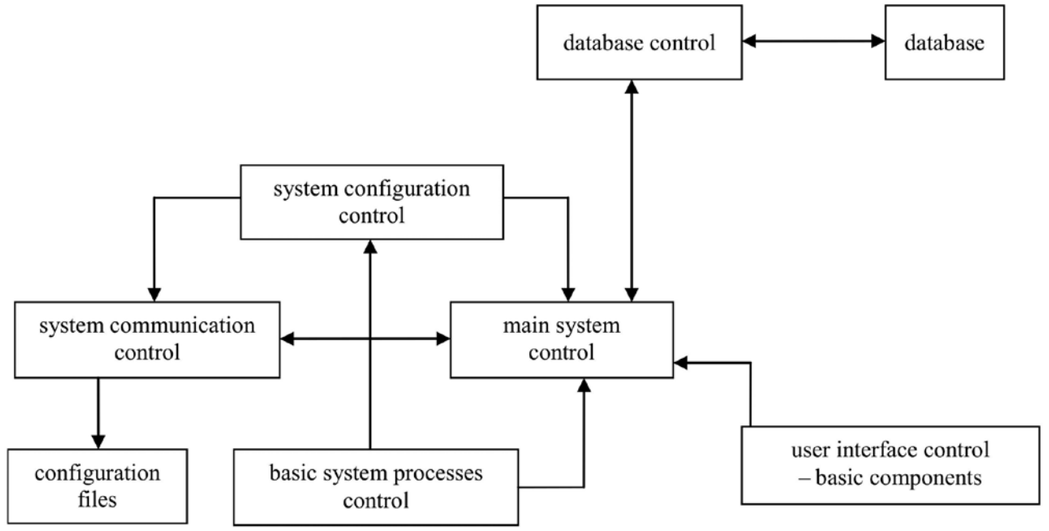


Figure 4: Design of the underground computer together with the database.

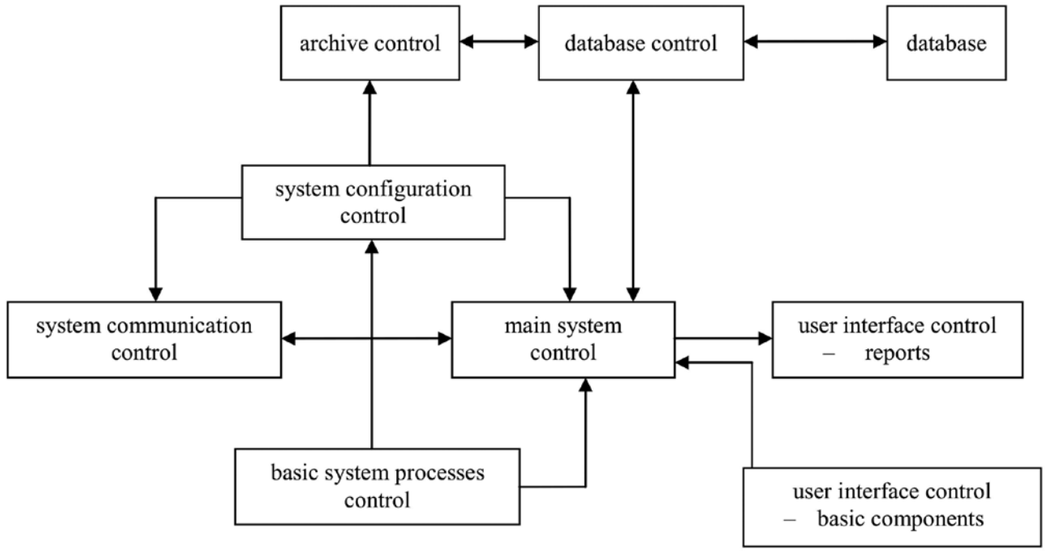


Figure 5: Design of the surface computer together with the database.

and operating experience of the authors. Based on the theoretical analyses made, the assumptions of software architecture modules and databases were developed. Due to the gaps and limitations caused by the computing power of a computer operating in an underground mine, the focus was put on collecting relevant information such as pressure measurement in powered roof supports and their position geometry. One of the elements of creating a database is to test whether the proposed structure and data resource correspond to the requirements set at the design stage. The designed software architecture together with the database will constitute the information base of the control system.

The architecture diagram for the software for the computer that will operate on the surface and one that will operate underground are shown in **Figure 4** and **Figure 5**.

THE CONCEPT OF SAFETY AND HAZARD ASSESSMENT

The electro-hydraulic system designed to control the powered roof support should perform its intended control functions even under damage or disturbance conditions in a predictable manner and with specified reliability. Measures taken to minimise the likelihood of such damage or disturbances and their extent depends on the level of hazard associated with the specific control function.

Research on the evaluation of the reliability of the implemented safety function for the electro-hydraulic control system of the powered roof support is aimed at reducing the risk of hazardous events to an acceptable level. The hazard reduction can be carried out based on standards[41-46], to optimally achieve the protection of the system. In the process of designing and constructing the

control system, the risks were analysed, and measures were taken to protect the operator from the existing hazards. The hazard assessment is the result of logical steps, allowing for systematic analysis. The system or the machine must be designed and constructed taking into account the results of the hazard assessment. The first step of the assessment is to identify system components (equipment) and later the sources of the hazard for all activities of the operation. The authors considered only those risk factors that have a fundamental impact on the assessment of the effects of a threat when estimating the hazard[20]. Four levels of hazard were adopted for research based on own experience.

1. Unacceptable – hazard reduction is necessary, otherwise, the system cannot be authorised;

2. Undesirable – hazard is only acceptable if the expenditure involved in reducing it is clearly higher than the effects achieved or if hazard reduction is not achievable;

3. Acceptable – the hazard is only acceptable if the expenditure involved in reducing it is significantly higher than the effects achieved;

4. Negligible – further investment in hazard reduction is not acceptable.

An individual assessment based on good practice and experience was adopted for the risk assessment. This method uses predefined value ranges and descriptive measures such as:

S_1 – negligible (the risk is very rare, the chance of an event occurring is low, a probability of no more than 10%),
S_2 – minor (light injuries, mild occupational disease, 11-30% probability),
S_3 – serious (serious injury to one or more persons or death of one person, probability 31-60%),
S_4 – severe (many people die, probability 61-80%),
S_5 – catastrophic (very many deaths and practically total destruction of the system, a probability above 81%).

In general, it must be assumed that the hazard is a combination of the intensity of the occurrence of safety *h* and its consequences *S*:

Equation 1

$$R = h \cdot S,$$

The total hazard associated with the use of the system consists of several hazards and therefore, the total hazard can be assumed as follows:

Equation 2

$$R = \sum_{i=1}^{n} h_i \cdot S_i$$

where h_i – the intensity of the *i*-th hazard and S_i – the consequences of the *i*-th hazard.

The probability of the *i*-th hazard can be determined.

Equation 3

$$p_i = \frac{h_i}{\sum_{i=1}^{n} h_i}$$

Expected impact per unit of time:

Equation 4

$$E_{(s)} = \sum_{i=1}^{n} S_i \cdot p_i$$

Additionally, as a result

Equation 5

$$R = E_{(s)} \cdot \sum_{i=1}^{n} h_i$$

The result of the assessment is presented in **Table 1**.

The parameter determining the level of hazard is primarily the severity of the damage that may occur as a result of failure to perform the safety function once it has been recalled. The consequences of failure to perform the exemplary control functions of the electrohydraulic powered roof support are almost always serious for the health and life of those operating the machine and those around it. The analysis of the required performance level (PL) is based on the identification of the tolerable hazard function[45].

When defining the level of safety assurance PL, we refer to it as the ability to perform safety functions under the expected conditions. There are five discreet levels of safety assurance marked as:

a. indicates the lowest probability of failure,
b. means the average probability of damage,
c. means a good probability of damage,
d. means a high probability of damage,
e. means the highest probability of damage.

Determination of the Safety Integrity Level (SIL) is based on the estimation of the value of hazard and the ability of the control system to reduce hazards[41]. As already mentioned above, the safety function can be set up in two different ways. The determined safety level of SIL and PL

Table 1: The result of the analysis designed to determine the level of the safety function.

Safety Integrity Level (SIL)	Probability of Dangerous Damage per Hour	Safety Performance Level (PL)	Hazard Assessment Method R
N/A	≥10^{-5} to <10^{-4}	a	S_1
SIL 1	3 10^{-6} to <10^{-5}	b	S_2
SIL 1	10^{-6} to <3 10^{-6}	c	S_3
SIL 2	10^{-7} to <10^{-6}	d	S_4
SIL 3	10^{-8} to <10^{-7}	e	S_5

for the tested control system was also compared based on the probability of accidental equipment failure. **Table 1** presents the results of the analysis of the safety function.

Table 1 presents how to assesses the hazard and its reduction and determines the Safety Performance Level PL and the Safety Integrity Level SIL. In the analysis of a given safety function, PL and SIL2 levels were obtained, and the estimated hazard is assumed at S2. The analysed electro-hydraulic control system performing the safety function is characterised by a safety level not worse than that required.

Research on the Development of the Electro-Hydraulic Control System

The control system together with the mechanical and hydraulic system is crucial and often determines the efficiency of the roof support. Therefore, it is well justified that scientific activity regarding the control system should be boosted. The search for a system that would allow for automatic operation without the need to position workers in the longwall is intensifying. The use of digital data – both for the roof support and the whole complex – shows that the demand for smart control has been continuously increasing.

Currently, it is not possible to eliminate the miners from the longwall. This is also not to be expected in the coming years. The main reason is that there are no measures that Energies 2021, 14, 697 9 of 16 would precisely specify the mining and geological conditions of each longwall. However, this does not limit the development of control systems, for which the requirements are increasing and will grow. The objective is to focus on works outside the mining area as much as possible. Here, the control systems are fundamental. Research in this area mainly includes work on the development of an electro-hydraulic control system. A testing station was designed with a virtual controller built in. The station is used to define the number of control system parameters (**Figure 6**)

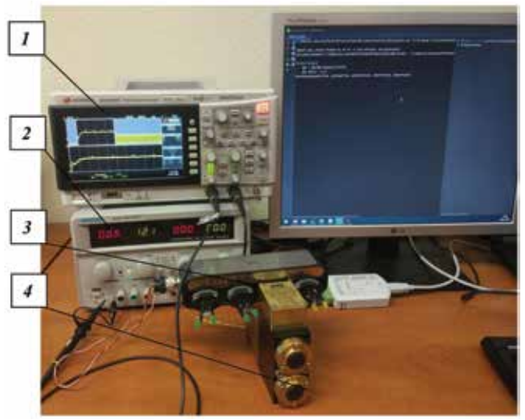


Figure 6: Test monitoring equipment, where 1 – oscilloscope, 2 – laboratory power supply, 3 – controller module, and 4 – solenoid valve.

The monitoring scope of the system is wide. It was used to determine the times for implementing the basic functions of the support such as the spreading and withdrawing of sections (extensions/slides of hydraulic legs mounted between floor bases and canopies). It measured the times of switching on the PWM signal and full signal supply for the basic functions of the powered roof support. The operating parameters of the control system obtained for individual phases of the section operation are shown in **Figure 7**.

The obtained results clearly indicate that the tested electro-hydraulic system has very low response times. This provides fast and reliable performance of the roof support. Such parameters make it possible to prepare both a comparative and sensitivity analysis of the control system and its components. Next, the results are used to adapt the control parameters to the mining and geological conditions of an individual longwall. It can, therefore, be assumed that virtual testing techniques applied for the systems that are already in use, new ones, or even prototypes can potentially facilitate their improvement. At the same time, the conditions to which these systems will be subject in real conditions are impossible to achieve in laboratory conditions.

THE CONCEPT OF DEVELOPING A PROCEDURE AS A BASIS FOR THE INTRODUCTION OF AN AUTOMATIC CONTROL SYSTEM

The development of a comprehensive design procedure, together with the procedure for conducting tests and the required safety assessment, is important in terms of adapting the system to the roof support structure and the conditions under which the system will operate. The procedure in **Figure 8** includes four stages. The results should be used by manufacturers of roof supports and control systems, as it presents the order of design, research, and production. The third stage, from a scientific point of view, is the most important one, as the positive or negative results obtained make it possible to analyse whether the assumptions made in Stage 1 coincide with the design in Stage 2. As a result of research into prototypes and the acceptance of prototype amendments. The production documentation is then developed as outlined in Step 4. The authors of the study included all possible points for safety and efficient use.

Analysis of the electro-hydraulic control system together with the visualisation of the operation parameters of the powered roof support in the conditions of adverse effects of the rock mass shows that the construction of the powered roof support must be adapted properly. It is important to prepare the structure of the roof support so the control system and the sensors can be mounted properly to achieve the right operating parameters and ensure the necessary safety level. The highest level of functional safety for the components comprising the control and visualisation system requires the use of all testing methods. In particular, this concerns the safety of the miners.

Identification of potential hazards associated with the emergence of hazards resulting from the operating

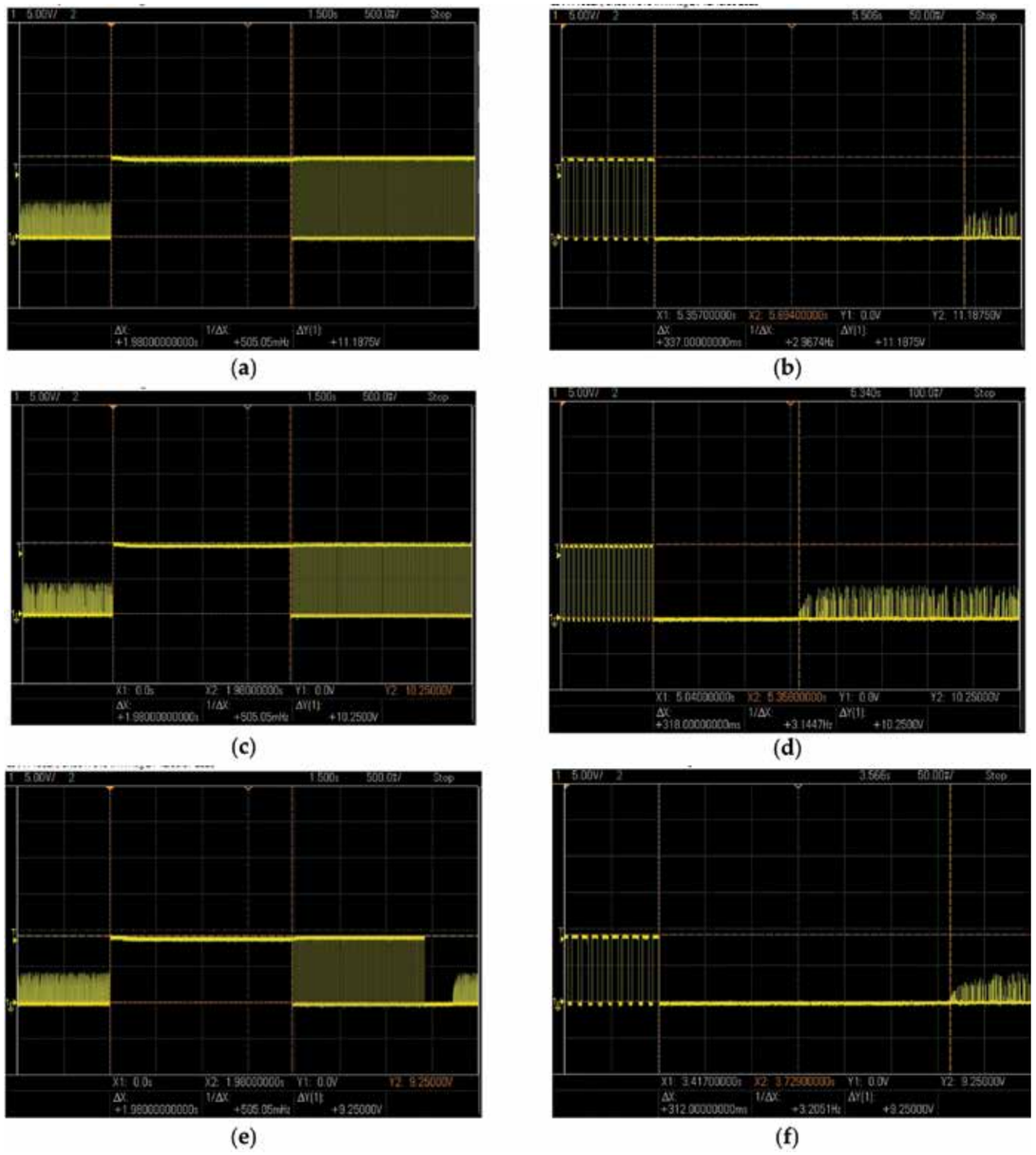


Figure 7: Switch-on time and delay of the Pulse Width Modulation (PWM) and full PWM signal for the function of sliding up and down the legs: (a) supply voltage of 12 V for switching on time ΔX = 1.98 s, (b) supply voltage of 12 V for delay time. (c) Supply voltage of 11 V for switching on time ΔX = 1.98 s, (d) supply voltage of 11 V for delay time, (e) supply voltage of 10 V for start-up time ΔX = 1.98 s, and (f) supply voltage of 10 V for delay time.

conditions of the control system is important. The mining and geological conditions in which longwall coal mining is carried out are one of the most dangerous. Step 2 includes a detailed safety assessment, which refers to the hazard assessment of the control system of the powered roof support designed for the operators. The hazard assessment will check whether the level achieved can be considered acceptable based on the possible occurrence of the hazard and the probability of its occurrence. The hazard reduction takes into account the hazard associated with the malfunctioning of the control system and must be designed in such a way that:

- it ensures the safety and prevents emergencies;
- defects in the computer hardware and software of the control system would not lead to dangerous situations;
- they are resistant to the loads resulting from their intended use and to the impact of dangerous situations;

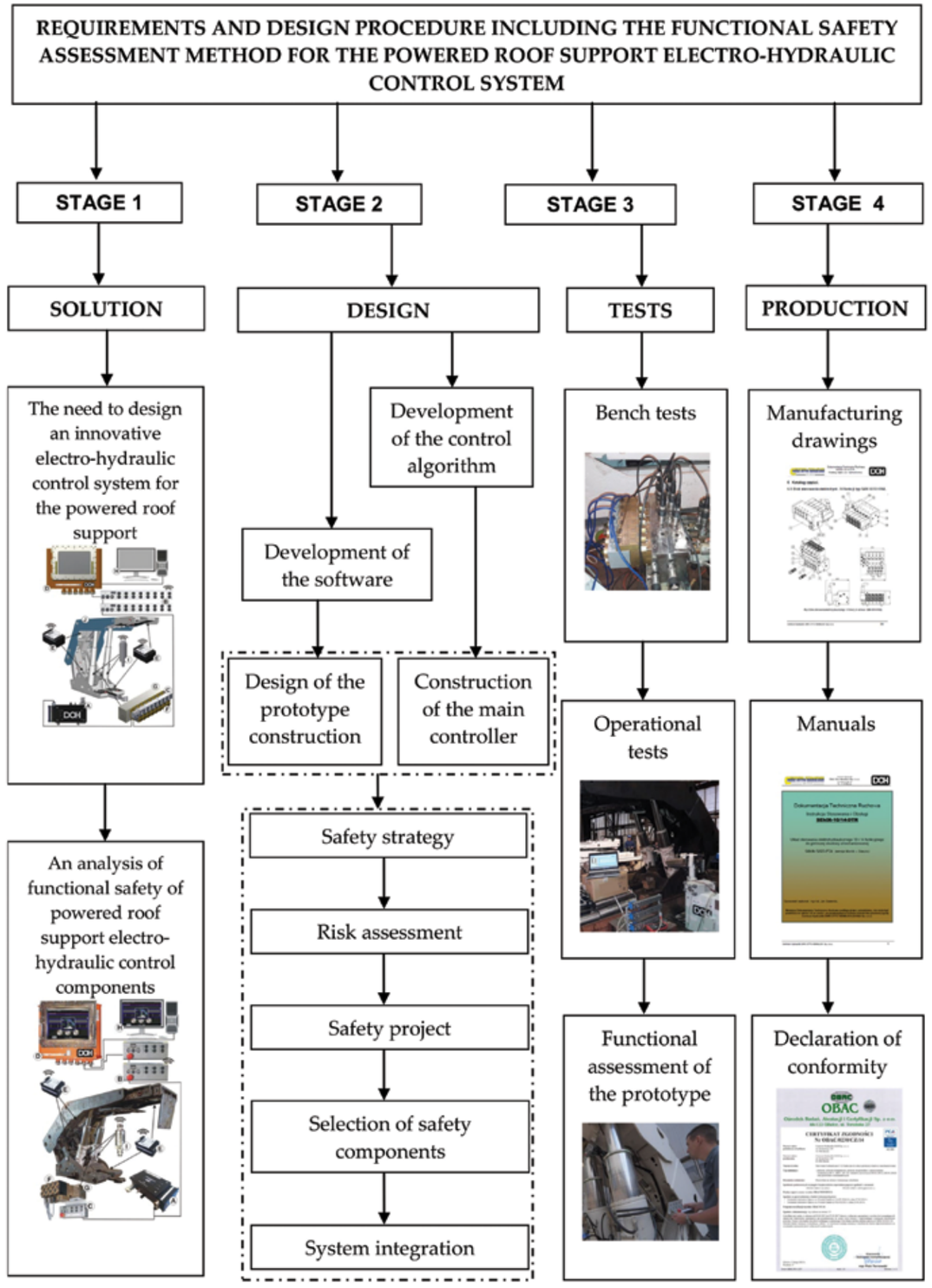


Figure 8: The procedure together with the procedure for testing and evaluation for the introduction of an electro-hydraulic control system and a visualisation system for underground mine operation.

– logic errors do not lead to dangerous situations;
– predictable human errors do not lead to dangerous situations.

Figure 8 presents a guide for engineers who design control systems. The manual is used following its established components, namely, when starting to work on a new system, the concept must be considered first, and then, design, research, and production must be considered. The guide (**Figure 8**) intends to organise and reduce engineers' working time. This procedure consists of four stages. In the first stage, the concept for the designed prototype of the system was taken into account together with the functional safety analysis. The second stage covered design aspects with the development of the control algorithm and software. The third stage includes tests. The research team designed bench and underground tests. The aim of this research is the functional ocean of the designed system. The last stage four is the introduction of the system into serial production. Here, manufacturing drawings, instructions for use, and a declaration of conformity are included.

The nature of the presented concept (**Figure 8**) is open, as it takes into account the possibility of introducing specific conditions in which the seam will be mined, and the selection system used. The procedure can be modified to fit the research and development of automatic control devices and future requirements.

The conditions in which the mining roof support operates are random. Consequently, the procedure must be used for every new mining longwall individually. The range of application should be adapted to calculated possible mining and geological conditions of a given area. Identified potential loads and requirements for the powered roof should be treated as a foundation of further research and calculations. Possible structural changes and other systems should be preceded by a thorough assessment of the condition of these conditions.

The procedure itself is open and flexible. This is crucial as this makes it possible to modify it depending on the conditions, requirements, and needs, as well as research capabilities. This applies to both manufacturers and users of the roof support.

The contractors who order a powered roof support should be aware that they must adapt the parameters and features for each longwall. They are responsible for the proper selection of the system that would fit the conditions in a given area. The safety of the miners is the most important. The support is the most expensive machine of the powered roof support complex, and its safe use impacts the economic efficiency of the entire mining operation process.

CONCLUSIONS

It is important to prepare the roof support in such a way that after it is installed in the longwall and launched, the automatic control systems take over the functions previously performed by the operator. Appropriate selection of the support section for mining conditions, equipping it with a set of sensors and a prepared intelligent control system, can together potentially fulfil expectations. The authors attempt to identify the main problems that need to be carefully considered, complemented by the knowledge gained from the research, and then to define the criteria. Based on the analysis of many tests carried out, the conditions (**Figure 8**) to be met for the powered roof support and its components have been clarified, which will allow preparing the structure of the support to meet the requirements necessary in terms of the automatic control system.

Based on the tests and analyses carried out for the resulting prototype of the electro-hydraulic control system, a detailed analysis of the safety function must be carried out before it is put into service as presented in Section 3 (Results). This analysis takes into account the required level of hazard and determines the level of safety integrity and the level of safety assurance with a probability of dangerous damage per hour. Based on the analysis carried out, this is a satisfactory level. This is of particular importance for the entire longwall complex.

Based on the design and research work on the development of an electro-hydraulic control system for the powered roof support to increase the efficiency of the entire complex, requirements and design procedures were developed together with the procedure for functional safety assessment.

The area of research and analysis in the third stage has provided new knowledge of equipment design. The developed system can have a huge impact on the efficiency of the work of the powered roof support and thus the entire longwall complex. In the future, this may result in a reduction in the number of workers during coal mining. So far, studies and analyses have not included such a comprehensive approach concerning increasing safety. The presented material expands the existing knowledge of control systems and visualisation of work parameters of the powered roof support and will be an important element in the process of effective use of machines and equipment in the longwall complex.

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Eickhoff Rebuild (ER) … 30 years OEM rebuild experience at Eickhoff Polonia

Within the mining industry Longwall has probably been one of the first within the extractive sector to embrace automation and underground coal mining performance. The need to deliver improved safety and productivity presents open challenges and a powerful incentive to develop new solutions and goes well beyond the synchronised movement of shields as the shearer passes along the face. The move towards longwall automation has been pursued enthusiastically by several of the major longwall equipment manufacturers and suppliers. Each company tends to concentrate on different aspects, however, there are common themes: health & safety, a reduction in manpower, productivity efficiencies, and timely maintenance. *Coal International takes a brief look at one of the industries most experienced longwall providers*.

Eickhoff and the mining industry are inextricably linked. Components for underground use were among the first products of the company – and when Europe‘s first bar coal cutter was put into operation as a complete Eickhoff system as early as in 1914, a virtually unique success story started in underground mining. It did not take long until Eickhoff coal mining machines were exported to all parts of the world, with a first bulk order coming in from Russia in 1926. And it was in the middle of the 1970’s that Eickhoff was the first Western supplier to be approved for mining equipment in China.

From the very beginning, the Eickhoff engineers have dedicated their experience and deep passion to the development of better and better machines with ever-increasing efficiency and reliability. By doing so, the limits of feasibility are often being redefined as is the case with the maximum cutting height of the shearer loaders: In 2001, the commissioning in South Africa and China of two shearer loaders designed for a cutting height of 5.5 m, was a world record. The year 2007 saw the first operation of the Eickhoff SL 1000 – with a cutting height of as much as 6 m. Meanwhile, a shearer loader for 7.2 m is operating at Bulianta Colliery in China which is, of course, another world premiere. And very soon the Eickhoff SL 1000 with a cutting height of 8.6 m will be put into operation – yet another world record!

Eickhoff underground mining machines are known for their robust and reliable design and excel by their quality in day-to-day operation.

they are more powerful, offer higher availability rates and have a significantly longer life than competing products. All that translates into production records.

Shangwan Colliery in China is a good example where the recording of a monthly production rate of over one million tons of coal as early as in 2003. An Eickhoff machine is also a record holder in Australia: Here again, an SL 750 shearer loader produced an output rate of more than one million tons of coal at Oaky North Colliery.

Apart from high reliability it is the continuous innovations which contribute to the non-stop setting of new production records and make the Eickhoff shearer loaders more efficient. The EiComatik system, for example, originally controlled the shearer loader speed in relation to the cutter motor load. EiControl initiated the start of automated cutting. EiCotrack, is another product Eickhoff have developed, utilising the chainless haulage system for shearer loaders which is now recognised as an international standard and comes in multiple versions and designs. These further developments have been, and are, regular award winners.

- Eickhoff started sales of used machines at discounted prices (compared to new machine) with well-known Eickhoff quality
- Rebuild as a service for our customers for their machines or when they buy used machines on the free market
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  - brush up
  - change of spare and wear parts – 100% Eickhoff original spare parts
  - modernisation of old equipment
  - AFC “fitting” – we offer solutions to fit your used machine to your conveyor (AFC)/excavation system/ coal face/roof support
  - service according to customer needs
- Presentation of rebuild process on factory trade show from 6th to 9th of September at Eickhoff Polonia in Katowice
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