

Scraping By

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**GLOBAL COAL MINERS
AND THE URGENCY OF A JUST TRANSITION**





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Global Energy Monitor (GEM) develops and shares information in support of the worldwide movement for clean energy. By studying the evolving international energy landscape and creating databases, reports, and interactive tools that enhance understanding, GEM seeks to build an open guide to the world's energy system. Follow us at www.globalenergymonitor.org and on Twitter [@GlobalEnergyMon](https://twitter.com/GlobalEnergyMon).

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ABOUT THE COVER

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GLOBAL COAL MINERS AND THE URGENCY OF A JUST TRANSITION

Ryan Driskell Tate, Dorothy Mei, Tiffany Means, and Satomi Sugaya

“Paying people to make the transition from one kind of economy to another is not welfare. Those who work with toxic materials on a daily basis . . . in order to provide the world with the energy and the materials it needs, deserve a helping hand to make a new start in life.”

—Tony Mazzocchi, labor leader
(Oil, Chemical, and Atomic Energy
Workers International Union), 1993.

EXECUTIVE SUMMARY

The coal industry is expected to shed nearly half a million mining jobs and 15% of the global workforce in just over a decade, even without climate commitments and coal phase-out policies. The potential for job losses in the short term signals the urgency for people-centered industrial transitions and planning across the mining sector even before coal-producing countries announce pledges to reduce coal use.

Global Energy Monitor (GEM) has released a first-of-its-kind public dataset of coal mining employment at individual mines. This enhancement to the Global Coal Mine Tracker shows that nearly half a million workers (414,200) operate mines that may reach their end of operation before 2035, affecting on average nearly 100 workers per day in the mining sector. Those coal miners will remain

vulnerable to layoffs and job losses, even in countries with no climate pledges.¹

The future of coal mine employment is starker at midcentury. By 2050—a timeframe within the career of an under-forty-year-old coal miner working today—nearly 1 million coal mine jobs (990,200) will no longer exist at operating mines under the coal industry’s foreseeable closures, potentially laying off over one-third (37%) of the existing workforce.

Coal mining jobs have an outsized role in remote coal regions where they are the anchors of economic activity and sustain ancillary workforces and employment in local consumer and information economies. The coal industry itself shoulders the responsibility for the sector’s unpredictable future. GEM has found that most mines expected to close in the coming decades have [no planning](#) underway to extend the life of those operations or manage a transition to a post-coal economy.

The climate commitments to phase out of coal power generation could accelerate ongoing trends in coal mining job losses even as employment in renewable energy and construction now [exceeds 50%](#) of total energy employment. GEM’s data shows that 148,900 miners work in thermal or mixed-grade coal operations that supply utilities in countries with legal, policy, or oral pledges to phase out coal power generation before midcentury. But the industry’s own operational practices means that 68,300 miners, almost one-half (46%) of those workers, are already at risk for job losses, with or without phase-out policies, because of anticipated mine closure dates.

After a year of explosive and deadly mining accidents, high-profile labor conflicts, and civil society resistance to mining operations, it is imperative that coal miners have the opportunity to pursue a more secure and stable future—and make a “just transition” toward new sectors of employment and well-paying jobs in clean and renewable sources of power.

1. Coal mine employment numbers throughout this report are rounded to the nearest hundredth and serve as an estimate. For more on our Global Coal Mine Tracker employment data and estimates, see our [methodology](#).

KEY REPORT FINDINGS INCLUDE:

- Nearly 2.7 million coal miners produce 93% of the world's coal, with the vast majority working in Asia (2.2 million jobs).
- The coal industry could shed 414,200 mining jobs by 2035—nearly 100 workers per day—regardless of climate pledges or coal phase-out targets.
- In the longer term, the mining industry's current operating practices and foreseeable mine closures could witness nearly 1 million job losses by 2050.
- China's Shanxi Province would be the most adversely affected by foreseeable mine closures, enduring 241,900 potential layoffs in the coal mining sector by midcentury.
- Even prior to making climate commitments to phase out coal, the world's ten largest coal-producing companies could shed up to 243,100 coal mining jobs by 2050.
- If countries and companies were to pursue plans to phase down coal to limit global warming to 1.5°C, only one quarter of a million miners (252,200), would be necessary to maintain production worldwide, given the current global average labor productivity of 337 workers per million tonnes of coal produced.
- Only 6% (148,900) of the coal miners working at thermal and mixed-grade mines are covered under current climate pledges by or before midcentury, necessitating widespread transition planning in the coming years.

INTRODUCTION

The climate movement has called for a shift away from fossil fuels in a manner that is fair, inclusive, and people-centered. This “just transition” toward a cleaner energy mix is a first-order priority in remote coal regions. As the largest source of [energy-related global carbon dioxide emissions](#) (15.5 billion tonnes), coal is the first fuel type expected to “phase out” in the coming decades. Without proactive planning, the end of coal could wreak havoc on jobs, local economies, household incomes, and community well-being.

Coal mine employment has an [immense impact](#) on local and regional economies. The “mining town” is an archetype of the community rooted in a singular economy and overreliance on coal employers for wages, tax revenue, and [in some cases](#), hospitals, schools, and pensions. The upheaval in coal country, absent a just transition, is already visible in hollowed-out “pockets of distress” that [lost mining employment](#) to company [bankruptcies and layoffs](#) in the 1980s and 1990s. The impending loss of additional coal jobs in the years and decades ahead could create similar economic effects.

The original framework for “just transition” stemmed from the labor movement, which has for generations sought solutions whenever workers lose their jobs to mechanization, automation, corporate offshoring, and outsourcing. Tony Mazzocchi, a U.S. union leader for the Oil, Chemical and Atomic Energy Workers, is often credited with coining the phrase after he first [began organizing](#) with environmental groups over toxic substances and occupational health and safety in the energy sector in the 1970s.

The global climate movement has since [broadened the term](#), and today, just transition is an integral part of the net zero equation. But it has only in recent years begun to receive the public consideration and financial backing it deserves. Whereas the first net zero commitments were made in the [mid- to late-2010s](#), the International Partners Group only launched the first “Just Energy Transition Partnerships” (JETPs)—agreements in which wealthier nations financially empower

coal-dependent developing nations to transition towards clean energy—in 2021.

While national and local governments and civil society organizations have made [hardfought](#) and piecemeal attempts to provide social assistance to coal workforces, tangible global initiatives have failed to materialize in much of the world. During the 2021 UN Climate Change Conference (COP26) in Glasgow, it was announced that [South Africa would receive US\\$ 8.5 billion](#) in support of its pathway to low emissions and climate resilience. After that, JETPs for Indonesia ([US\\$ 20 billion](#)), Vietnam ([US\\$ 15.5 billion](#)), and Senegal ([US\\$ 2.7 billion](#)) soon followed.

Yet the creation of these just transition arrangements has arrived less than eight years before 2030—the year the international community needs to collectively halve global greenhouse gas emissions [to limit](#) global warming to 1.5°C under the Paris Agreement. The planning is overdue and necessitates careful spade-work to ensure “[untried](#)” initiatives live up to their full potential to support workers in the world’s coal-producing powerhouses.

The lag in just transition policy action owes much to the scope and scale of the challenge ahead. Public policy makers and planners have acknowledged the [uncertainty](#) about the best practices and toolkits necessary for a secure transition, and a general lack of information on global and local workforces. Until now, public data on global coal mine employment was unavailable at the facility level, making it difficult to identify site-specific concentrations of coal miners or to hone transition planning for coal communities in future years.

The top energy and labor organizations have identified the necessity for granular information about mining jobs. The International Energy Agency (IEA) [noted](#) the inherent limits of current overreliance on national figures for coal mining workforce statistics, and there is no “substitute for better data collection, especially when it comes to subnational data.” Back in 2020, after

conducting a series of listening sessions with fossil fuel workers and stakeholders, the Labor Network for Sustainability similarly pointed out the necessity for information on “where fossil-fuel activity is occurring, such as fossil-fuel power plants and extraction sites” and “the timeline for drawing down these activities” to ensure that “communities plan proactively for transition ahead of closure, rather than dealing with the situation reactively once a closure has been announced.”

In an effort to help bridge this data gap, Global Energy Monitor has tracked employment size in its Global

Coal Mine Tracker, covering 4,300 active and proposed coal mines and projects responsible for 90%+ of global coal production. This dataset now includes nearly 2.7 million coal miners directly employed at operating coal mines around the world. When possible, GEM has found exact workforce figures, and, when information is otherwise unavailable, developed a machine learning model to estimate the size of those workforces where the number of jobs were previously unreported ([see methodology](#)).

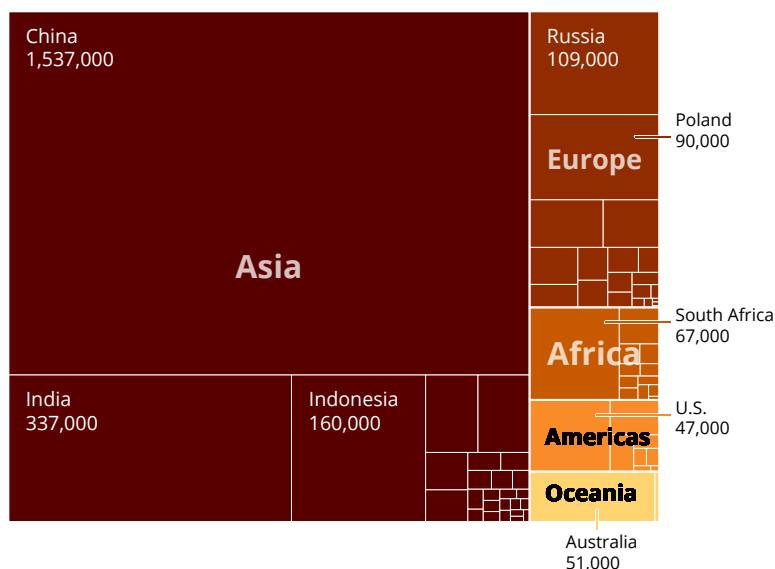
THE GLOBAL COAL WORKFORCE: MINERS BY THE MILLIONS

“Coal miner” is a catchall term for someone who works in a mine, but in practice the job refers to a [variety](#) of trade skills and labor processes necessary to extract coal from the ground: general technicians, mechanics, engineers, electricians, machinists, drillers, haul truck drivers, excavator operators, carpenters, and blasting workers.

The coal mining industry today employs nearly 2.7 million such workers in 70 countries at 3,232 active coal mines that produce more than 90% of the world’s coal, according to GEM’s workforce data. The majority of these coal miners, over 80%, are based in Asia. China, India, and Indonesia—the [top three](#) coal-producing countries—together have three times the number of coal miners as the rest of the world combined (Figure 1).

Figure 1: Where are the world’s coal mine workers located?

Estimated coal mine workforce by country and region



Source: Global Coal Mine Tracker, Global Energy Monitor

China has over 1.5 million coal miners who produce over 85% of its coal, which accounts for half of the world's output. They work in the country's largest 1,220 mines, capable of producing over 1 million tonnes of coal per year, mostly in the northern coal provinces. Up to an additional [1 million](#) to [1.5 million](#) workers may work in mining, processing, and transportation at some 3,000 smaller coal mines scattered across the country. The northern provinces of Shanxi, Henan, and Inner Mongolia mine over one-quarter of the world's coal and employ 32% of the global mining workforce—approximately 870,400.

India, the second largest coal producer, has a workforce about half the size of China's Shanxi province. The country employs 337,400 miners at its operating mines, though some studies [suggest](#) the local mining sector has four “informal” employees for every one direct employee. The coal belt of eastern India produces the bulk of the country's thermal grade coal for power generation. The share of coal mining employment in the powerhouses of Jharkhand, Odisha, Chhattisgarh, and West Bengal [make up](#) 1–2% of the state workforce, not to mention informal employment and the related coal workforce in power stations and heavy industry.

Within the coming year, Indonesia is expected to [boost production](#) enough to rival India's output for the first time. The country already ranks [third](#) in the world for production and employs 159,900 coal miners at its active operations—almost 40% of them in East Kalimantan, the most intensively-mined province in the country. The mining sector has spread across [5 million hectares](#) of East Kalimantan and now [comprises](#) 35% of local GDP. The IEA has since named the province the most coal-dependent subnational region in the world, with coal mining employment [comprising](#) 4–8% of the workforce. The reality has [heightened the stakes](#) for Indonesia's JETP, which must address the needs of coal miners in the phase-out of coal power.

Once the heartland of industrial coal power, Europe now employs 311,300 coal miners—most of them in the coalfields of Russia, Poland, and Ukraine. Russia's 108,600 coal miners labor for the most part in Kemerovo, producing [228 million tonnes](#) in 2022. By contrast, Ukraine's coal mining employment (28,400), which once rivaled Russia in size, has now fallen as much as 67% since 2019 after the occupation of the Donbas and onset of the Russian invasion last year, which led to the closure and abandonment of mines.

Within the European Union, Poland is the largest miner in the sector, and national employment has remained steady in recent years at 89,600 coal miners, more or less, in 8 voivodeships (provinces). Almost two-thirds of Polish coal miners work in the historic mining district of Silesia, where workers have organized in recent years [against](#) planned mine closures. Other EU countries where coal employment remains relatively high include Germany, the Czech Republic, and Bulgaria.

South Africa, the most [coal-dependent country](#) in the G20, employs the majority of coal miners in Sub-Saharan Africa with 67,300 workers spread across 78 active mines. The state of Mpumalanga stands as the largest employer of coal miners, responsible for mining 90% of the country's coal, which contributes to [25%](#) of GDP—the most of any economic sector. One previous [study](#) noted that just four local municipalities—eMalahleni (Witbank), Steve Tshwete (Middelburg), Govan Mbeki, and Msukaligwa (Ermelo)—had the most coal-reliant economies. Outside of South Africa, the continent's coal workforces are heaviest in Mozambique, with 11,800 coal miners, Zimbabwe, with 3,300, and Zambia, with 3,100.

The remainder of the coal mining workforce lives and works in the Americas and Oceania. Those regions employ the smallest share of coal miners, even though they're home to the U.S. and Australia, two of the

world’s largest coal-producing countries. The U.S. has about 46,900 miners, and Australia has 51,300—figures

that belie their yearly production because of the use of large-scale mechanization of their industries (Map 1).

WHO ARE THE WORLD’S COAL MINERS?

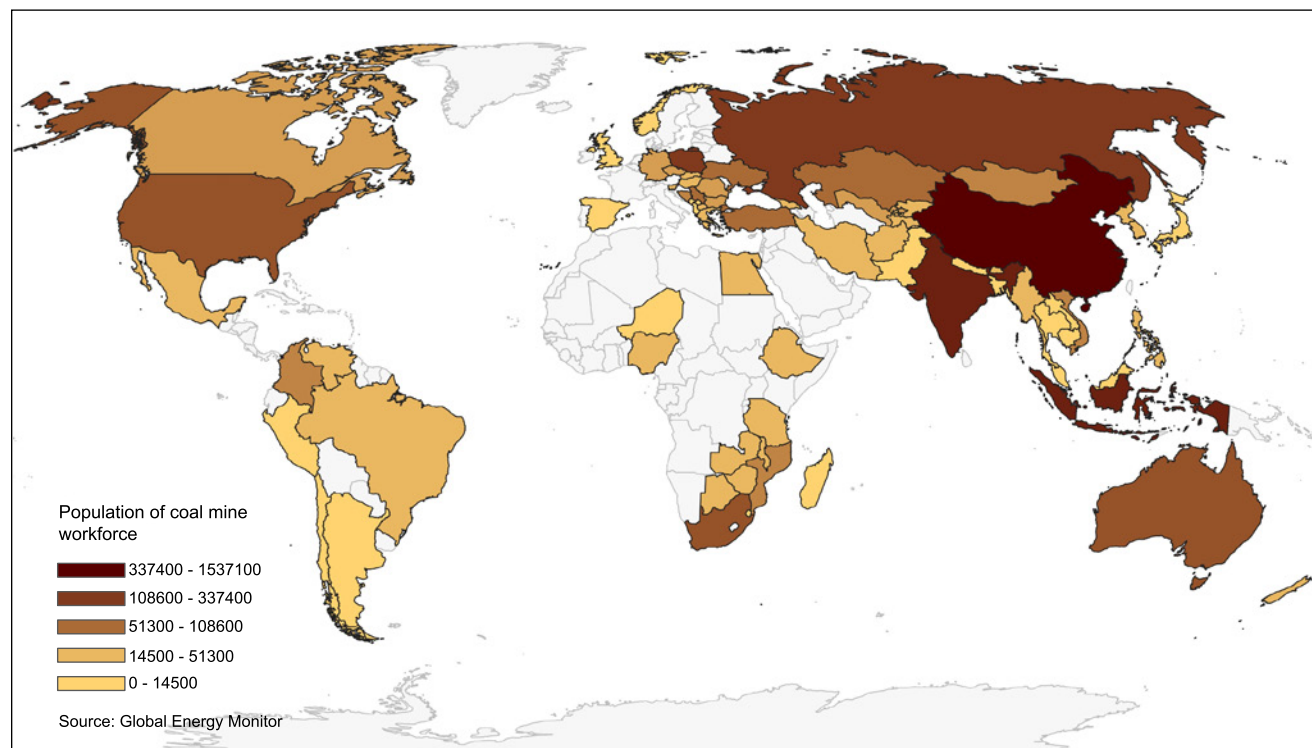
Coal mine employment data provide us insights into the local workforce: Where does the typical coal miner work, at what type of mine, producing what kind of coal, and just how much? Today, the average coal miner works for a state-owned enterprise, running a small-scale operation with a roster of about 300–400 coworkers. They labor shoulder-to-shoulder in underground mines in the far-flung reaches of China’s northern and midland provinces, or across the mining belt of eastern India. By year’s end, they have helped the company haul just under two and half million tonnes of bituminous coal out of the pits.

But the social conditions and labor experiences of mining vary from place to place. Back in 2021, a coal miner in a small town in Krygyz, for instance, [heaved](#) a

pickaxe at the coal face 12 hours a day. He stopped only to load coal cars or reinforce the thin timber frame that supported the roof overhead. There were 52 miners on the rolls at the time, each of them working bare-chested in knee-length shorts, mining 70 tonnes per day.

Out in the world’s largest and mechanized mines, coal miners maneuver haul trucks the size of small houses and churn out ten times that amount of coal every hour. They commute to remote locations, sometimes “[flying in and flying out](#)” cross-country, like thousands of men and women enlisted as “FIFO” coal miners in the surface pits of the Bowen Basin in Australia. They work on a roster of 1,500 or so, sprawled across an open-pit in orange safety coveralls and steel-toed boots, operating on rotating shifts, 24 hours a day, 365 days per year.

Map 1: Which countries have the most coal miners at active operations?



SPOTLIGHT:

A UNIONIST'S PERSPECTIVE ON COAL MINING IN HWANGE, ZIMBABWE

Thobekile Shoko is a 36-year-old unionist working as a Regional Officer for the National Mine Workers Union of Zimbabwe (NMWUZ). She has helped organize coal miners and their families at more than eight coal mines in Hwange, Zimbabwe.

She spoke to Global Energy Monitor about her experiences in Hwange for this report. The interview has been edited for length and clarity.

Thobekile Shoko: I was born in Hwange and grew up in Hwange. My father was a coal miner and later I got married to a coal miner. The life of a coal miner is very painful. Despite the miners working hard, they get the lowest salaries. They are the most poor people around. Their life is so painful that they can't build their own homes.

I got involved with NMWUZ after I led 2,000 women as a spokesperson for a demonstration in 2017. When we did picketing, our spouses had taken more than five years without salary. After the demonstration that took more than five months, NMWUZ approached to see if I was interested in learning labor laws and human rights. That's when my journey started with NMWUZ.

Coal miners and their families and community as a whole face serious health problems. There is so much coal dust caused by blasting, power stations, and trucks carrying coal. There is too much coke smoke from coking ovens and water pollution on the Deka river, where many companies throw their waste. In terms of agriculture, there is irreversible damage to the environment caused by cutting down trees to open for mining—soil erosion and deforestation.

Workers are treated unfairly when it comes to safety issues. There is not enough PPE. Working conditions are very bad, especially for those working on coking ovens. Some now suffer from eye problems. There are always accidents in different mines. There are even injuries from people getting burnt in the mine. Some suffer from pneumoconiosis. There is too much intimidation.

Hwange is a small town with a population of 20,000 people, where you can find different tribes of more than 16 speaking languages. Because of many mining activities, it is no longer the interesting town it used to be before. As a person who has grown up and spent her whole life here, Hwange has been the best and safest town because it is also close to the biggest Hwange National Park.

A coal mine in Hwange, Zimbabwe



Anita Gould, "[Coal Country](#)," August 14, 2022, CC BY-NC 2.0

But Hwange has turned sour. The noise made in the mines has caused animal conflict. Elephants, lions, and snakes are now coming into the community, running away from the activities and the noise. Our health as a whole and our coming generation is at risk. There are issues of seam fires, where we have many children being burnt. From my own perspective, looking at Hwange in five years, people will be destitute and Hwange will be a ghost town.

I think about issues of climate change, since coal is recorded as the biggest polluter in the globe. I think there is a dire need for the climate change activists to come down to Hwange and teach people about climate change. I noticed that people have no idea about it after one organization, the Center for Natural Resource Governance, came in with the teaching on the issues of climate change. People have no idea and still believe that all the weather patterns issues are God's doing. My plea is if teachings or workshops might be brought to the miners and the community in terms of adaptation and mitigation.

I am one person who is fond of democratic movements, and who loves helping and teaching people about their rights. My goals are to end corruption, exploitation, oppression and to achieve full gender equality in law and practice of human rights—also to better the life of a coal miner by advocating for better salaries and health.

As of 2023, Hwange currently has a major [proposed coal mine](#) under development, and in 2022, the [Hwange coal power station](#) was one of only two coal power projects in the world to successfully receive financing for the refurbishment of its units.

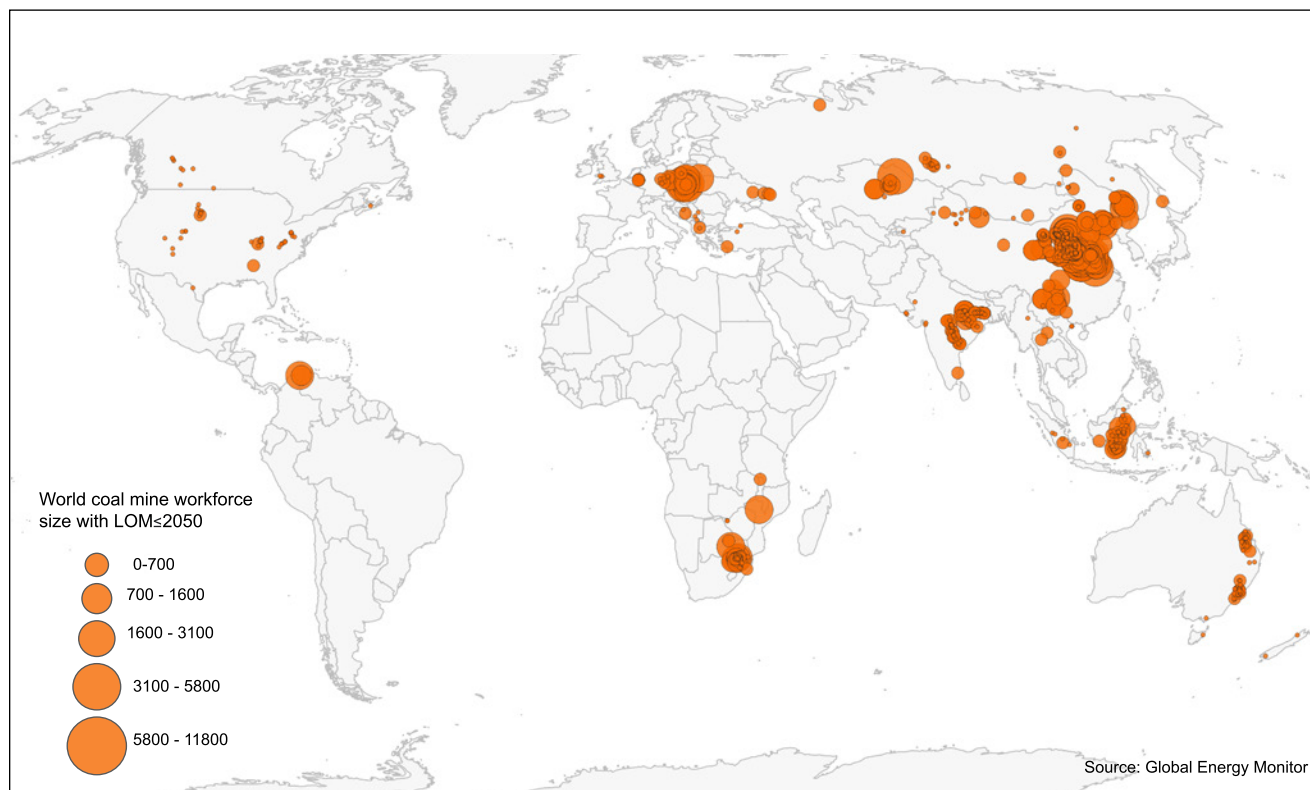
COAL MINE CLOSURES ARE INEVITABLE, REGARDLESS OF A CLEAN ENERGY FUTURE

Coal miners face the harsh prospect of job layoffs due to scheduled mine closures and a market shift toward [cheaper](#) wind and solar power generation, whether or not their home country has a coal phase-out policy in place.

The most imminent threat to the future of coal mine employment today is the industry’s intended closures when existing mines reach their end of operation. GEM’s [Global Coal Mine Tracker](#) collects data on an operation’s reported “life of mine” (LOM)—that is, how long coal companies intend to extract coal at the site under existing leases, permits, available reserves, and other economic considerations. When that information is unavailable, GEM collects data on reserves-to-production ratios, an industry practice to determine how long a mine could extract coal at its current output (see [methodology](#)).

According to GEM’s data, the coal industry is scheduled to shed 7% of the current global coal mine workforce (195,200 miners) as a result of operations with LOMs ending before 2030. By 2035, operators could further reduce the current global mining workforce by 15% (414,200) when additional mines reach the end of their planned operations. Mines with LOMs ending before 2040 could see a 22% reduction (581,800 miners) in the current global workforce. And by 2050, a date that is within the career of coal miners employed today who are under the age of forty, nearly 1 million coal mine jobs (990,200) at nearly 1,000 coal mines will no longer exist under the coal industry’s own expected closure dates. The regions with the greatest potential for layoffs include China, India, Poland, and South Africa. (Map 2)

Map 2: Where are potential coal mining job layoffs by 2050?



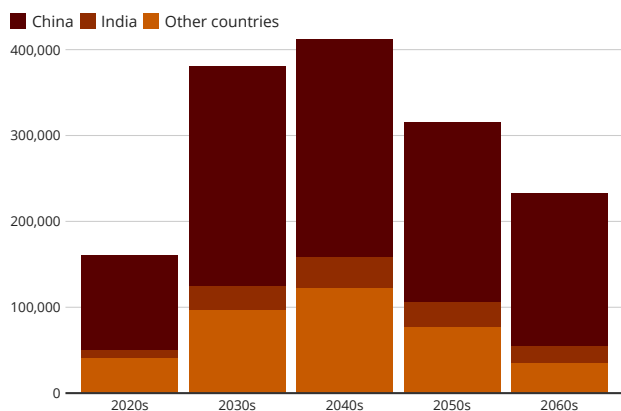
When the projected layoffs in major coal-producing countries are analyzed by decade, it becomes evident that the most significant workforce reductions will occur in the 2030s and 2040s. This is primarily because numerous coal mines in GEM’s [Global Coal Mine Tracker](#) are approaching the end of their operational lifespan in the next twenty-five years. China will witness the most substantial portion of these potential layoffs, with more than half a million miners facing the risk of job losses in those two decades. India ranks second in terms of potential layoffs during the same periods (Figure 2). Given the industry’s expected mine closures, major producers like South Africa and Indonesia will likely witness the same trend with potential layoffs frontloaded in the near-term, reiterating the need for workers to remain at the forefront of planning JETPs. By contrast, Poland and Türkiye

will experience the bulk of their mine closures and potential closures after the 2040s (Figure 3).

The coal industry has one primary mechanism to extend the life of a mine, which is to propose a mine extension project. Yet this process can involve raising financial capital, undergoing new rounds of permitting, and acquiring property rights. The obstacles to extension projects are not lost on the industry itself: A survey of current proposals [reveals that](#) only one quarter of coal mine projects under development (113 out of 426 total) are extensions or expansions of existing mines, signaling that the industry maintains a strong preference for greenfield proposals. The operations which are actively [pursuing plans](#) to prolong mining are centered in China (36), Australia (21), India (15), and Russia (13). In 2022, several high-profile mine

Figure 2: Potential coal mine layoffs by decade

Approximate number of workers by country and estimated decade in which their mine will reach the end of its life

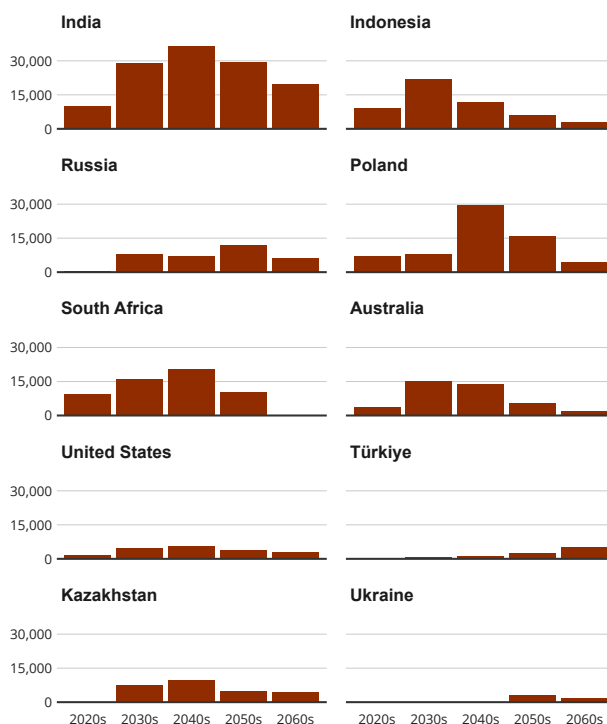


Note: Does not take into account any national or international climate commitments or policies to phase out coal.

Source: Global Coal Mine Tracker, Global Energy Monitor

Figure 3: Coal mine layoffs outside China

Approximate number of workers by estimated decade in which their mine will reach the end of its life, among the 10 countries with largest coal mine employment, excluding China



Note: Does not take into account any national or international climate commitments or policies to phase out coal.

Source: Global Coal Mine Tracker, Global Energy Monitor

expansion projects provoked intense civil society opposition and international attention at critical junctures—such the [Garzweiler mine](#) expansion in Germany.

Coal producers have instead [slashed](#) nearly 40% of their new mine development and expansion plans since 2021, with 895 million tonnes of proposed coal mine capacity outright canceled or gone dark in public reporting, and showing no sign of ongoing progress over the past 2–4 years, even with record high coal prices to buoy the industry. The IEA has [stated](#) that no new mines or mine expansions are necessary to achieve net zero in 2050, and UN secretary-general

António Guterres has [said](#) that all planned coal projects must be canceled around the world.

The employment situation could worsen in the near term since LOM data was unavailable or insufficient at 1,267 active mining operations in the Global Coal Mine Tracker, accounting for 509,700 workers. The typical [extraction period](#) of thermal coal mines is 8–26 years, suggesting that nearly 751 thermal coal mines for which data was unknown could see closures before 2050, potentially impacting a further 398,300 to 409,500 coal miners.

WHICH COAL PRODUCERS WILL BE HARDEST HIT?

In order to attain net zero emissions, a substantial reduction in coal production and the number of operating coal mines is imperative. As such, analyzing the coal companies that yield the highest output, and therefore have the most run-of-mine coal to trim, can provide some insights into the companies which might be most adversely affected by layoffs.

A list of the top ten global coal producers (Table 1) reveals that some of the hardest-hit producers will likely include household names within the mining sector, such as Coal India, China Energy, Glencore, Peabody Energy, and the Siberian Coal Energy Company.

These top ten coal producers are collectively responsible for nearly 30% of the world’s total coal production and employ approximately 694,800 coal miners. Up to one-quarter of a million miners (243,100) in these companies could be laid off due to LOM closures concluding before the year 2050. Coal India (73,800 layoffs) and China’s Jinneng Group and Shandong Energy (104,500 combined layoffs) can expect to be particularly impacted. The fact that all three of these producers are also major state-owned operators exemplifies just how imperative it is that governments remain involved in planning for coal worker transitions.

Table 1: Top 10 Coal Producers and Potential Loss in Coal Mining Employment

Company	HQ Location	Coal Production (million tonnes)	Coal Mining Employment	Potential Layoffs from “Life of Mine” Closures to 2050
Coal India	India	658	308,000	73,800
China Energy	China	484	24,100*	8,200
Jinneng Group	China	228	113,700*	53,300
Shandong Energy	China	167	73,200*	51,200
China Coal	China	153	27,100*	8,600
Glencore	Switzerland	134	8,800	8,400
Shanxi Coking Coal Group	China	132	88,000*	22,600
Peabody Energy	USA	116	5,200	1,900
Shaanxi Coal and Chemical Industry Group	China	108	26,700*	12,300
Siberian Coal Energy Company (SUEK)	Russia	108	20,000	2,800

Source: Global Energy Monitor, Global Coal Mine Tracker, 2023

*China mine employment data includes only operations with capacities over 900,000 tonnes, and employment size could be higher for those operators if accounting for smaller coal mines.

WHICH COAL REGIONS WILL BE HARDEST HIT?

Just as workers who are employed by the top coal-producing companies may be most vulnerable to layoffs, those who work in the world’s top coal-producing countries may be, too.

Zooming in on the top ten coal-producing countries (Table 2) reveals that workers in mining-heavy China, specifically those in China’s Shanxi Province, could be among the most adversely affected. GEM’s analysis shows that the Shanxi Province alone holds nearly twice the number of coal mining jobs (587,900) as all of India (337,400)—a staggering number given that India is the world’s second-largest coal producer and employer of miners. And due to LOM closures

occurring by 2050, Shanxi is projected to shed nearly half (241,900) of these jobs.

Workers in Poland’s Silesian Voivodeship may be some of the next most vulnerable, followed by miners in South Africa’s Mpumalanga Province, those in Indonesia’s East Kalimantan Province, and those in Queensland, Australia. The United States can also expect to be impacted by closures, as [West Virginia](#), including the mining-intensive [Appalachia region](#), ranks on this list as well.

The impacts to the local peoples and economies of these granular locations could be dire unless a managed transition is underway.

Table 2: The provinces or states with the highest coal mining employment in the world’s 10 largest coal-producing countries

State or Province	Workforce Size	Production (million tonnes)	Country	Potential Layoffs from “Life of Mine” Closures to 2050
Shanxi	587,900	1085	China	241,900
East Kalimantan	62,100	289	Indonesia	16,900
Queensland	29,600	263	Australia	16,600
Kemerovo	67,000	228	Russia	7,500
Mpumalanga	53,900	217	South Africa	35,100
West Virginia	12,500	78	United States	2,000
Karaganda	19,600	345	Kazakhstan	14,400
Silesia	69,600	33	Poland	35,300
West Bengal	70,800	30	India	5,200
Saxony	2,500	22	Germany	1,900

Source: Global Energy Monitor, Global Coal Mine Tracker, 2023

WORKERS AT RISK

Whether in small-scale “artisanal” mines in Karaganda or large-scale industrial operations in West Virginia, coal mining poses shared dangers and risks around the world. This past year, hundreds of workers died globally from underground explosions, roof cave-ins, and machinery accidents. One of the more high profile accidents was a catastrophic collapse of the pit wall at the [Axla League coal mine in China](#) (2023) where initial reports found five people had died and 48 were missing. China Labor Bulletin, a NGO that tracks workplace accidents in the country, documented 69 reported [coal mine-related accidents](#) and deaths in 2022, and 23 [so far](#) this year. In the United States, thirteen coal miners [died on the job](#) last year from instances of drowning, electrocution, roof and sidewall collapses, machinery-related accidents, and carbon monoxide poisoning, and six more [have died](#) so far in 2023.

Coal mine methane continues to pose a global safety risk as underground explosions occur with some regularity: 51 people died and more were injured at the [Listvyazhnaya coal mine in Russia](#) (November 2021) in one of the worst disasters in recent years; 41 workers died at the end of last year in a [gas accident](#) at a coal mine in Bartın, Türkiye (October 2022); five workers died at the [Lenin coal mine in Kazakhshtan](#) (November 2022); six workers died at a coal mine in Orzkai [in Pakistan](#) (November 2022); and nine workers died at a coal mine [in West Sumatra, Indonesia](#) (December 2022), to name just a few high-profile cases. Already this year, eleven workers died at a coal mine [in Colombia](#) this March.

Miners also face hazards from extreme weather patterns whose increasing frequency is fed in part by the release of methane and other greenhouse gasses into the atmosphere during coal production. In July 2022, at least nine coal miners lost their lives [in Pakistan](#) when heavy rains resulted in rainwater accumulating 15–18 meters inside of a Jhampir village coal mine, trapping workers underground.

The concerns over human rights remained all too frequent in the mining sector this past year. On major news outlets, stories ran about coal operators in Afghanistan relying on [child labor](#) and operators in North Korea using “[enslaved South Korean prisoners](#)” and “orphans” to produce coal for power generation and industry.

Whatever the case, workers and their communities in some countries have found means to resist. In the United States, around 1,000 coal miners at Alabama’s Brookwood Mine [took strike action](#) for nearly the past two years against Warrior Met Coal after failed contract negotiations for better pay, better schedules, and more time off. They took their stand outside the mine gates all the way to Wall Street. They weren’t alone in calling for industrial actions. In April 2023, around 10,000 coal contractors [went on a multi-day strike](#) in India’s Talcher coalfield; over 500 Mozambique workers [went on strike](#) at the Moatize mine in May 2022; and workers at four BHP mines in Australia [came close](#) to a strike action in September 2022.

WHAT IS THE IMPACT OF THE COAL “PHASE-OUT”?

Coal-fired power generation is the largest source of energy-related CO₂ emissions globally, and the primary source of emissions reductions necessary to meet the targets of the Paris Climate Agreement is a rollback in coal use. To align with that goal, modeling by the [IEA](#) and [others](#) finds OECD countries should eliminate coal power by 2030 and the rest of the world should do so by 2040. But as detailed in GEM’s [Boom and Bust 2023](#) report, the world is not on track for the steep reductions in coal power necessary to meet the Paris Agreement.

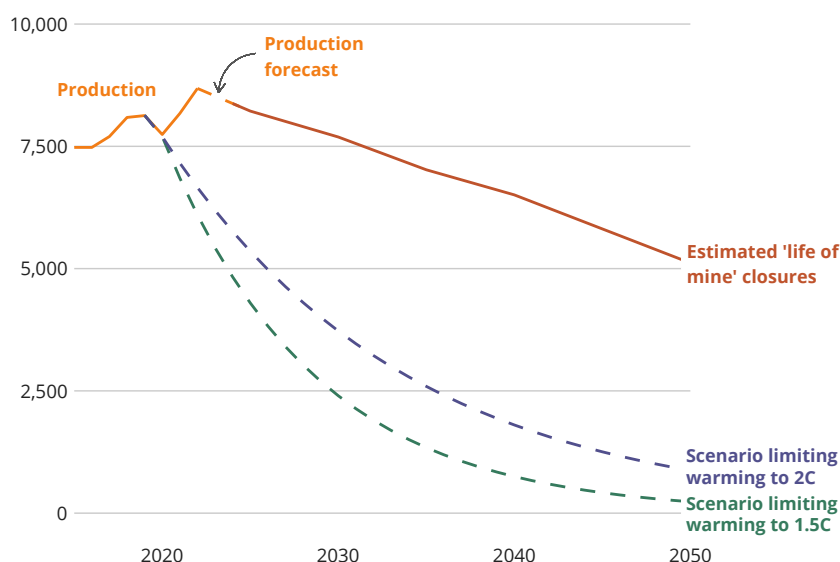
The policy commitments to phase out coal power generation will certainly impact the livelihoods of coal miners. Coal mine operators are expected to close mines that currently produce three billion tonnes before 2050—impacting almost one million coal miners. But even steeper cuts are necessary under climate scenarios for the Paris Climate Agreement and net zero scenarios.

Coal mine supply must phase out [11% per year](#) from 2020 until 2030 to remain in line with the Paris Climate Agreement, according to the Production Gap Report produced by the United Nations Environmental Programme and partners. But planned mine closures represent only 27% of the production cuts necessary to keep global warming to 1.5°C by 2040, and only 31% of the cuts needed to remain within reach of 2°C by 2040 (Figure 4).

The prospect of 1.5°C and 2°C phase-out scenarios would necessitate a just transition for over 90% of all coal miners working today. Only approximately 252,200 coal miners would be necessary worldwide under a 1.5°C scenario by 2040, and approximately 607,600 under a 2°C scenario by 2040, given the current average labor productivity of 337 workers per million tonnes of coal produced and the cuts in output necessary to meet those climate targets, as shown in the Production Gap Report’s earlier supply side analysis.

Figure 4: Coal mine supply requires steeper cuts to meet climate targets

Potential coal production under different scenarios, in million tonnes



Source: Global Coal Mine Tracker, Global Energy Monitor

Coal-producing countries with national commitments prior to 2030 and 2050 would need to plan immediate assistance for a relatively small number of coal miners—144,000—who work in thermal coal mines that supply utilities for power generation. In contrast, there are over one million workers in thermal coal mines in countries that haven’t made commitments to phase out coal. (Figure 5)

As for coal-producing countries with pledges prior to 2050, only 6% of the global coal mine workforce (148,900 coal miners) will be impacted by current national coal power commitments that will affect thermal and mixed-grade mines.

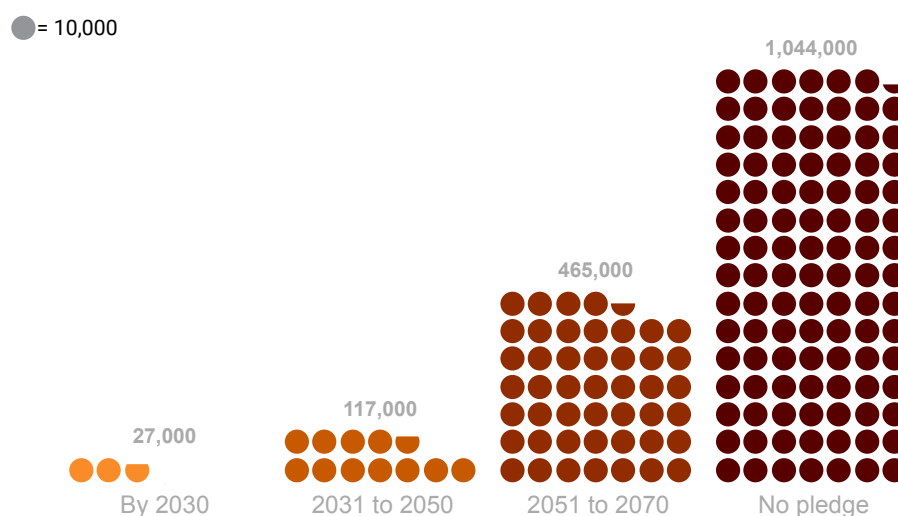
The IEA’s [Announced Pledges Scenario](#) (APS), where all announced government climate pledges are met on time before 2050, would require coal supply to make twice as many reductions as currently planned with life of mine closure dates. By 2050, coal supply would need to fall six times faster to remain within reach of the IEA’s Net Zero Emissions (NZE) scenario,

the pathway necessary for the global energy sector to achieve net zero carbon dioxide emissions. Under the APS, the IEA has [estimated](#) the entire coal sector could lose two million jobs within this decade, before 2030. But most coal power pledges have yet to impact the true epicenters of global coal supply. As a result, most pledges will initially impact coal power plant workers and related midstream employment in shipping and handling.

While most projections show the transition to renewable energy will create millions more jobs, those jobs may not be in the same communities and could require new skillsets or different crafts. Labor mobility is low across much of the OECD, and changing jobs can be [costly](#) for workers. Within North America, fewer than [one percent](#) of Canadian workers move for work each year, and only [1.6%](#) in the U.S., suggesting coal miners would have to become exceptions to national norms should they relocate en masse for a transferable sector work elsewhere (e.g. jobs in quarrying or critical minerals mining).

Figure 5: Only a fraction of thermal coal mining jobs are covered by coal phase out pledges before 2050

Estimated number of workers at thermal coal mines in countries with coal phase out pledges



Source: Global Coal Mine Tracker, Global Energy Monitor

If coal companies and state-owned enterprises dump thermal assets to rein in emissions or for economic survival, workers could experience a rash of unplanned layoffs. The coal companies that have made [full or partial commitments](#) to net zero by 2050 include major private and investor-owned producers who will be at the forefront of these sectoral transitions: major met coal operators (Teck Resources, ArcelorMittal); thermal operators headquartered in countries with phase-out targets (CEZ, RWE Power, Anglo American); and thermal operators headquartered in countries with no coal power phase-out targets (Glencore, BHP, Bumi Resources, AGL Energy, Sasol). (Table 3)

The coal industry has demonstrated efforts to diversify its portfolio in recent years given the economic reality as well as the imperative to reduce carbon emissions. The majority of coal miners today are employed at operations that produce thermal coal only, with an estimated size of 1,653,600 workers, more than 61% of the total employment in the coal mining sector. There are approximately 292,900 additional miners working in mixed-grade mines that produce thermal coal for power generation and metallurgical grade coal for steelmaking or other industry.

Coal companies have begun to sell or divvy up thermal assets. Anglo American has already [divested](#) most of their coal mines, and BHP has announced

the intention to sell its [Mount Arthur coal mine](#) in Australia, though it sought a life of mine extension to operate until 2030, after it received no buyer. Glencore and Rio Tinto now engage in the production of various metals and critical minerals. Glencore set an objective of becoming a net zero total emissions business by 2050. To achieve this, it is managing a decline in its coal operations while simultaneously increasing the adoption of renewable energy sources to decarbonize its energy supply. Since 2019, it has closed [four coal mines](#) ([La Jagua](#), [Calenturitas](#), [Hlagisa](#), and most recently [Newlands](#)). It also plans to close two additional coal mines in the near term, and at least six additional mines by the end of 2035.

The majority of SOEs have diversified their portfolios in China: While they have long been major coal producers in the country, in recent years, they have also emerged as prominent investors in renewable energy developments. China Energy, the largest state-owned mining and energy company, also ranks among China's [top five](#) central enterprise investors in renewable energy projects. The company holds significant influence in the country's economy. Currently, renewable energy accounts for [28.5%](#) of its total capacity, with coal-fired power plants comprising 72%. To comply with the government's renewable energy promotion, the company aims to increase clean energy's share to over [50%](#) of its energy portfolio by the end of 2025. Jinneng Group, another major producer, is

Table 3: Coal Companies and Net Zero 2050 Commitments

Company	HQ	Production (million tonnes)	Employment at Active Coal Mines	Net Zero by 2050
Glencore	Switzerland	134.11	8,800	Y
RWE	Germany	99.08	3,600	Y
Bumi Resources	Indonesia	86.64	7,400	N
BHP	Australia	52	900	Y
Anglo American	UK	36.86	4,500	Partial
Sasol	South Africa	36.7	7,500	Y
AGL Energy	Australia	28	800	Partial
Teck Resources	Canada	23.75	1,600	Y
ČEZ	Czech Republic	16	2,400	Y
ArcelorMittal	Luxembourg	9.74	10,600	Y

Source: Global Energy Monitor, Global Coal Mine Tracker and [Climate Action 100+](#)

also making strides in renewable energy. As of the last [company report](#) released in 2022, renewable energy accounted for 18.58% of its total installed capacity, including 1,085 megawatts of photovoltaic power and 795 megawatts of wind power capacity.

In light of India’s commitment to achieving net zero emissions by 2070, Coal India is also making efforts towards diversification by shifting its focus to renewable energy, particularly solar power. As part of its

broader plan to reduce its carbon footprint and work towards achieving net zero carbon emissions, the company is actively implementing a 3GW solar power program by 2025–2026. The specific timeline for reaching net zero greenhouse gas (GHG) emissions remains undisclosed, but the director of Coal India [explained](#) earlier this year, “This transition is going to take place . . . the current situation cannot continue forever. This carbon emission has to be reduced if the world is to survive.”

FROM LABOR-INTENSIVE TO MECHANIZED OPERATIONS

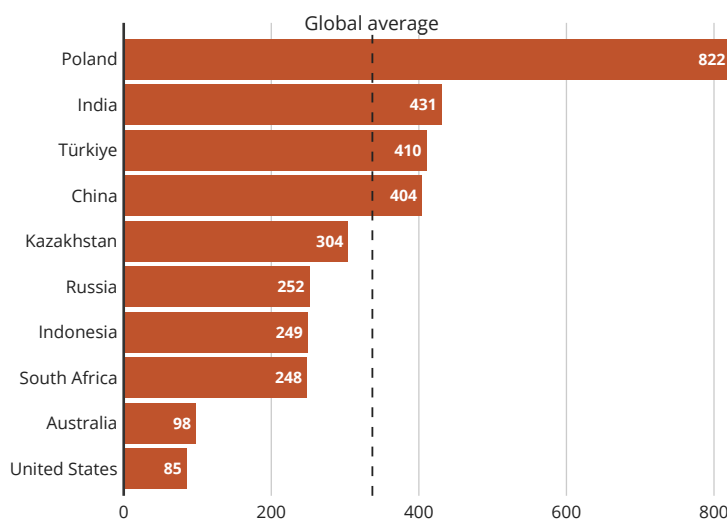
This prospect of lost jobs is not new to the coal industry. During the last decade, the coal sector has sloughed off [millions of jobs](#) in the name of safety and technological “efficiency”—replacing workers with machines. The global trend towards highly mechanized coal mines was historically rooted in efforts to [weaken](#) worker control over the job, though geological conditions also created constraints. Today, coal mining is more capital intensive than labor intensive in many parts of the world, and the size of the labor

force is often contingent on the choice of mining methods and the extent of mechanization.

On average, global operators require 337 workers per million tonnes of coal produced (Figure 6). The typical underground mine requires more coal miners than a surface operation just given the logistics to lift coal out of the ground, hoist unstable roofs, install air conditioning and ventilation systems, work near acidic waters, drill through hard rock, and extract large volumes in inch-thick seams.

Figure 6: Workers employed per tonne of coal produced

Estimated number of workers employed per tonne of coal produced in the ten countries with largest coal mine workforce



Source: Global Coal Mine Tracker, Global Energy Monitor

The major coal producers in the U.S., Germany, and Australia require fewer than 100 employees to mine one million tonnes of coal per year; but other large producers, such as Russia, Kazakhstan, and South Africa need twice that number. The most mechanized mines in the U.S. and Australia come outfitted with drone monitoring, automated longwall machines and driverless haul trucks, compact conveyor technology, and gas level monitoring to improve safety. The integration of advanced technologies into the mining workplace has led to a significant shift towards autonomous operations, minimizing the need for large workforces.

One outlier is Poland, the ninth largest coal producer in the world, which requires 822 workers per million tonne, much more than any of the other major coal producers (Figure 8). The country relies predominantly on underground operations and also has an active trade union to [stave off](#) attempts to thin out of employment. The JSW Group, the largest Polish producer of coking coal, employs roughly 27,700, but

LIFE AFTER MINING

Coal miners often have the [skills necessary](#) to shift into other careers within the energy sector or other low-carbon industrial sectors should governments and companies create those opportunities.

Coal companies can prevent sudden shocks to workers and coal communities if they take proactive steps to plan for mine closures associated with the anticipated end of a life of mine. One such step toward a fresh lease on life for miners is to offer them priority consideration for job opportunities triggered by mine closures. For example, [coal mine reclamation](#), the rehabilitation of land after coal mining operations have ceased, emerges as a promising prospect and serves as a bridge to employment for numerous workers facing abrupt layoffs. Myriad benefits exist for coal owners and miners alike when mine reclamation is performed by the local workforce.

Reclamation work (which includes infrastructure demolition, earthmoving, and revegetation) utilizes

it produces just 13.84 million tonnes of coal— on par with the production of Whitehaven in Australia, a company that employs roughly 415 coal miners.

China requires just over 400 workers per million tonnes of coal, a product of its [yearslong investment](#) in “smart mines” and “intelligent mine construction.” The government’s mining policies in the last decade have encouraged the closure of smaller mines, consolidation and integration of operations. [As of 2022](#), 572 smart mines have been established and the number of “intelligent mining faces” has risen to 1,019, a significant increase from the 80 reported in 2018.

While these high-tech operations lead to cleaner and more efficient processes, they also result in a decrease in job opportunities. The Shaanxi Coal and Chemical Industry Group’s “intelligent” production capacity accounts for 99% of its operations, leading to a reduction of [14,000](#) underground miners. In 2022, the number of underground coal miners nationwide decreased to [60,000](#).

similar skillsets as mining activities, making it simpler for miners to switch from production to reclamation tasks and simpler for coal companies to efficiently fill employment openings. It also requires a sizable workforce and guarantees employment for typically 2–3 years after mine closure.

These reclamation processes could also include coal mine methane mitigation of abandoned mines. After operation, coal mines can continue to leak methane until properly sealed, and [research suggests](#) that abandoned coal mines may pose a serious climate concern now and increasingly in the future, especially given the sheer number of mines that will close. Without proactive planning and post-mining mitigation procedures, abandoned mines can continue to leak emissions for decades.

Immediate job creation solutions such as these are vital to the just transition of coal communities. While they won’t replace mining employment for all

workers, they will mitigate mass layoffs and help provide a bridge to future employment.

Following the completion of land reclamation, abandoned or decommissioned coal mining sites frequently undergo transformation into areas intended for alternative purposes, including residential and commercial utilization. In recent years, more and more abandoned coal mines have been repurposed into sites for renewable energy projects. For example, in southwest Virginia, disused coal mines are undergoing a conversion process to become solar installations, with the capacity to provide substantial renewable energy to the electric grid. Another illustrative instance is the ongoing construction of the world's largest [floating solar farm](#) situated on a coal mining subsidence area in China's Anhui Province.

Although the solar and wind sector pays slightly less, on average, than the fossil fuel industry (extraction workers in the U.S. earn an annual mean wage of [US\\$ 62,530](#) compared to [US\\$ 48,890](#) for solar

photovoltaic installers, for example), miners transitioning into the renewables workforce can look forward to a high degree of job security. According to Allied Market Research, the global alternative energy market size is forecasted to grow at a compound annual growth rate of [10.3%](#) from 2022 to 2031. Meanwhile, the fossil fuel energy market is expected to grow [5.3%](#) from 2022 to 2031. However, such employment transition programs, while successfully creating numerous job opportunities, may necessitate the acquisition of fresh skillsets or engagement in different crafts.

Job loss isn't the only way miners are impacted by coal closures. In some instances, coal serves as the bedrock for entire community infrastructures. The mining town of Glenden in Queensland, Australia, which now [faces dissolution](#) in the wake of Glencore's Newlands coal mine closure, is just one example of this, and is all the more reason why early just transition planning must no longer be considered nice-to-have, but a necessity.

THE STATE OF JUST TRANSITION PLANNING

Sustaining a trajectory below the 1.5°C threshold demands swift dismantling of the worldwide coal infrastructure. [IPCC analysis](#) underscores the necessity for all OECD nations to phase out coal by 2030, while the remaining countries should follow suit by 2040. Presently, a number of countries have outlined their intentions to discontinue coal-related operations by 2030, while others have varying timelines, with some planning later or not at all.

Just transition policies remain urgent in Slovakia, North Macedonia, New Zealand, Germany, and Canada, where 2030 target dates will require some form of closure of existing thermal coal mines within the next six years. The efforts made in recent years by some countries, such as Canada, Germany, and Spain, to explore equitable approaches in the process of phasing out coal can offer lessons in planning for a just transition.

Canada's Task Force on [Just Transition for Canadian Coal Power Workers](#) and Communities, which was established in 2018, has led to the creation of several just transition initiatives, including its [Canada Coal Transition Initiative](#), which invests \$35 million into worker transition training centers and US\$150 million into a fund aimed at helping impacted communities diversify from coal by investing in infrastructure.

As Germany endeavors to phase out coal usage by 2030, the experiences of [two coal mining phase-downs](#) in the Ruhr area and Lusatia from the previous century can offer some insights into effectively managing the social dimensions of just transitions. Germany's evolving just transition approach initially prioritized preserving jobs in coal and steel sectors, but it gradually shifted to focusing on developing new industries, job opportunities, and improving quality of life in affected regions. This shift included establishing vital

infrastructure, fostering academia-industry collaborations, and integrating cultural and recreational activities, reflecting a move from reactive to proactive policies. The cornerstone of this change was the acknowledgment that regions couldn't solely rely on historical foundations; they needed to harness their history while simultaneously pursuing a diverse array of industries that could significantly influence the available options to facilitate a transition away from coal.

Spain, which also has a 2030 net zero target, is at a very advanced stage of energy transition, having closed all of its coal mines as of December 2018 and scheduled the total closure of its coal-fired power plants ahead of 2030. Often considered a pioneer in just transition, its policies include early retirement for miners 48-years-old and above; job security for younger workers who will be retained and given clean energy apprenticeships; and a US\$ 271 million (€250 million euros) fund to be invested in mining communities from 2019 to 2027. At the close of 2022, it was announced the country would also receive US\$ 942 million (€869 million euros) from the EU's Just Transition Fund. And in a global first, Spain's Climate Change and Energy Transition Law includes an obligation to approve just transition strategies every five years to deal with the ongoing effects of decarbonization. While the deal has been hailed by many as a [model agreement](#), Spain admits there is still work to be done.

Coal miners that work in countries without phase-out pledges remain at greater risk, since they may go unprotected by countries that delay just transition planning.

In the [three leading](#) coal-producing nations, approximately two million individuals employed in the coal mining sector face increased vulnerability without prompt and adequate just transition planning. China aims to significantly increase its non-fossil energy consumption and cap coal capacity additions, but a clear plan for a complete phase out of coal is yet to be established. India has set a goal to achieve net zero

emissions by 2070, but it has called for a [“phase down”](#) of coal rather than an immediate “phase-out,” indicating a gradual reduction in coal usage.

On the other hand, Indonesia has shown more ambition by signing the Coal to Clean Power Transition statement during COP26, committing to accelerate the phase-out of coal into the 2040s, contingent on receiving international financial and technical assistance.

However, all three countries face challenges in implementing a just transition plan to support the shift away from coal. In China, for instance, the establishment of the [Industrial Special Fund](#) by the Ministry of Finance in 2016 aimed to allocate US\$ 14 billion (100 billion yuan) primarily for the reemployment and resettlement of 1.8 million workers in the coal and steel sectors, including about 1.3 million individuals in the coal industry and 500,000 in the steel industry. While this fund may appear substantial, its adequacy might be questionable, given that the average individual is projected to receive slightly over US\$ 6,887 (50,000 yuan). Comprehensive updates regarding the implementation and progress of this funding are inadequately documented online.

In India, the concept of just transition is still largely [unknown](#) to a wide range of stakeholders, and the government has [no plan](#) to introduce a just transition policy to its national policy framework. Indeed, as the International Forum for Environment, Sustainability, & Technology (iForest) has shown, coal-reliant emerging economies face a [formidable journey](#) in their quest to shift away from fossil fuels, given the substantial capital required for this endeavor.

The JETPs [established](#) during COP26—held in Glasgow in 2021—represent an incipient collaborative financing mechanism designed to assist a subset of heavily coal-dependent emerging economies in achieving an equitable transition to cleaner energy sources. One of the primary objectives of this approach is supporting a just transition that protects vulnerable workers and communities affected by the move away from coal. This support also extends to managing the societal

repercussions inherent in this shift, including ensuring adequate training, creating alternative employment opportunities for affected workers, and fostering fresh economic prospects for impacted communities.

The financial support offered by JETPs predominantly originates from affluent nations. Over time, the list of contributors has expanded to involve multilateral development banks, national development banks, and development finance agencies. The [first JETPs](#) exhibited a commitment of US\$ 8.5 billion, backed by France, Germany, the United Kingdom, the United States, and the European Union, to bolster South Africa. In 2022, a second partnership was [unveiled](#) during the G20 Bali Summit, where Indonesia was slated to receive an initial US\$ 20 billion package of both public and private funding spanning three to five years to facilitate its use of renewable energy and reduce its reliance on coal. Vietnam is the third country to adopt a JETP and will be receiving an initial

[US\\$ 15.5 billion](#) over the next three to five years to support its goal of achieving a number of new energy transition targets.

Indeed, JETPs present significant potential for assisting emerging economies in managing energy transitions. However, the financial support provided by JETPs falls significantly short of the actual funding required. For example, the overall funding for South Africa's just energy transition requirement has been estimated to be [US\\$ 98.7 billion](#), and India is expected to require around [US\\$ 900 billion](#) over the next 30 years for its own just energy transition.

With the climate clock ticking, the imperative to phase out coal and halt reliance on fossil fuels becomes increasingly urgent. It's crucial to underscore that the welfare of individuals must be given paramount importance throughout this transformative process. Not having a plan leaves miners stranded in the dark.

METHODOLOGY

Global Energy Monitor's Global Coal Mine Tracker is a public registry of the world's coal mines and proposed projects. The tracker provides asset-level information on ownership structure, development stage and status, coal type, production, reserves and resources, methane emissions, geolocation, and other categories. In 2023, the tracker added information on mine-level employment for 3,229 operating coal mines. Those figures include 1,348 coal mines for which company or government data on coal miners was publicly available, and 1,881 coal mines for which GEM used a machine learning model to estimate the operating workforce size, prepared in collaboration with postgraduate researchers at Massachusetts Institute of Technology (MIT). (For the full methodology, see "[estimating coal mine workforce size](#)" on Global Energy Monitor's Wiki platform.)

This is the first open source dataset to provide granular information on global coal mine employment. The most recent global assessments of coal mining employment, from the World Bank and the IEA, have relied on nationally reported job figures from 2019. Both organizations have parsed and factored out direct versus indirect jobs to varying degrees, and the IEA has sought to distinguish cross-sector employment, such as extraction, transport, washing, processing, construction, and equipment manufacturing, and employment in operating mines versus employment building new projects or modernizing existing operations.

The IEA published its inaugural [World Energy Employment Report](#) last year and reported that around 6.3 million employees worked in coal supply (extraction, transport, washing, processing, construction, and equipment manufacturing) in 2019. Coal mining itself, or the "raw materials" sector, comprised

60% (3.78 million) of those jobs, though some of those workers were involved in building new projects rather than operating existing assets, though it's unclear exactly how many. The World Bank had previously put coal and lignite mining employment at 4.7 million for the same year (2019), but included formal and informal workforces, based on aggregated data from the 20 largest coal-producing countries (out of 70). As such, the tallies of coal mining jobs presented by the World Bank and IEA for the same year (2019) differ by one million workers (4.7 million and 3.7 million respectively).

GEM's Global Coal Mine Tracker has documented nearly 2.7 million coal miners active at operating coal mines. GEM's data reflects the significant changes to the industry over the last three years, since 2019, including the sectoral changes of the Covid-19 pandemic, interruption in coal mining jobs and temporary closure of operations in Ukraine and Russia since the Russian invasion, and layoffs in Romania's coal mining Jiu Valley.

What GEM's data has left unaccounted for is the sizable coal mining workforce who operate the smallest coal mines in the Asia-Pacific region that produce 7% of the world's coal—about 560 million tonnes. That workforce is almost entirely in China, where 1,200 modernized mines produce 85% of the country's coal, but nearly 3,000 mines produce 15% of the country's coal in operations that GEM's Global Coal Mine Tracker is in the process of adding. The rest of the workforce is likely in Indonesia and India, which have a sizable share of informal and day workers operating in the mining sector.

The full methodology is available at "[estimating coal mine workforce size](#)" on Global Energy Monitor's Wiki platform.