Mining for talent

Addressing regional workforce challenges in a changing resources industry

OECD

OECD Local Economic and Employment Development (LEED) Papers

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This paper examines the evolving challenges facing the mining sector, where rapid technological change, soaring global demand for critical minerals, and the green transition are transforming job requirements and regional economies. It provides an overview of the mining workforce and identifies significant workforce gaps arising from issues of the availability of workers and skills, and the attractiveness of the sector and regions where it exists. Drawing on policy examples from OECD countries, the paper explores policy measures and industry-led initiatives to expand the local talent pool, bridge the skills gap, transform the sector's reputation, and enhance regional appeal. These good practices aim to provide a practical foundation, which regions can tailor to fit their local economic and demographic contexts.

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Table of contents

FIGURES

INFOGRAPHICS

BOXES

Executive Summary

Achieving a modern mining workforce requires expanding the local talent pool, bridging skills gaps, transforming workforce perceptions, and strengthening regional appeal.

Mining is the key economic driver in many regions where it exists. It directly contributes to GDP and employment, and it creates multiplier effects from related upstream and downstream activities. For example, it directly accounts for up to 69% of regional GDP and 28% of jobs in Chile's Antofagasta region.

Once seen as a declining industry, mining is now resurging due to growing global demand for critical minerals and its role in the green and digital transitions. Demand for rare earth minerals is projected to grow by 400 to 600% in the next decade. At the same time, companies are investing in cleaner extraction methods, innovation partnerships, and circular economy practices, which can drive regional innovation with spillovers into sectors like robotics, data analytics, and environmental management.

As the sector adopts more green and automated business practices, the demand for manual labour is expected to decline. For example, almost half of all mining jobs in North America are at high risk of automation by 2030.

At the same time, the demand for technologically skilled labour and new roles in environmental management is increasing. There is a need for new roles, such as the programming and maintenance of automated solutions, environmental compliance officers, renewable energy integration specialists, and carbon footprint analysts.

These changes contribute to regional labour shortages in mining, driven by issues of the lack of availability of workers and skills, and the lack of attractiveness of the job and sector:

Shortages of people

The mining workforce is characterised by an ageing demographic and significant gender imbalances, which underscore the need for a renewed talent pipeline. Across OECD countries, over 72% of the workforce is over 35 years old and less than 17% is female.

To address the lack of available workers, policies use targeted measures to expand the talent pool. These efforts include targeted recruitment initiatives, like Australia's QMEA programmes, tailored training and apprenticeship schemes, such as Mining Essentials for Indigenous individuals in Canada and, overall, by promoting workplace reforms with mentorship programmes that help bridge gender and cultural gaps in the sector.

Shortages of skills

Skills shortages and mismatch between industry needs and workers' skills and preferences persist due to the demand for new roles. In three Australian regions, labour market tightness in the mining sector is 2.5 to 3 times higher than the average industry in that region. In a cross-national survey, seven out of ten leaders in mining identified talent shortages as a barrier to meeting production targets and strategic goals. The increasingly high-tech nature of work and demand for new roles mean that current educational systems struggle to keep up.

Addressing skill shortages involves policies that aim to boost the local skills supply by strengthening the alignment of educational offerings with industry demands. These include specialised academic and vocational programmes, relocating educational opportunities closer to rural communities, apprenticeship schemes, micro-credential initiatives, and data-driven curriculum updates designed to align workforce competencies with emerging technological and sustainability demands. Examples include the Polytechnic Institute of Leiria in Portugal, the Corporación Alta Ley in Chile, and the Process Academy pilot in Finland's Kainuu and Central Ostrobothnia regions.

Job not attractive

Negative perceptions of the industry and its work deter potential workers. Seven out of ten young people would not consider a career in mining, and nearly three-quarters believe that mining does more harm than good to society.

Improving the appeal of mining jobs focuses on enhancing working conditions and clear, proactive communication about modern mining practices. Initiatives like Australia's Attraction and Retention Project Hub and Fundación Minería y Vida in Andalusia, Spain help counter negative perceptions and highlight competitive remuneration and career progression opportunities.

Place not attractive

Some mining regions are located in rural and often remote rural areas. These remote locations, with limited access to services and opportunities for work outside mining, can deter workers and their families. The use of fly-in-fly-out workers can limit the potential positive spillovers to local communities.

To make mining regions more attractive places to live and work, policies aim to boost strategic investments in infrastructure and provide support for worker relocation and economic diversification. For instance, initiatives such as housing and integration support by International House Joensuu (North Karelia, Finland) and economic clustering exemplified by Arizona's "Sun Corridor" contribute to making mining regions more vibrant and sustainable.

1 Introduction

The mining sector, where it exists, is a cornerstone of regional economies, contributing to employment, economic growth and overall well-being. In resource-rich countries, such as Australia, Canada, and Chile, the sector can account for up to one-sixth of GDP and employs hundreds of thousands of workers in occupations ranging from drill operators and drivers to engineering and data analytics professionals. The oversized impact of mining is even more evident in resource-rich regions, for example, in Chile's Antofagasta region, where the sector represents almost 69% of the local economy and 28% of jobs (OECD, 2023[1]). Beyond its immediate economic contribution, the mining sector also supports a host of adjacent sectors and services. One study estimates that each mining job leads to seven new jobs over a period of five years, with even stronger local job multiplier effects in transport, as well as rental and accommodation services (Fleming and Measham, 2014[2]).

Long viewed as a declining sector, mining is experiencing a resurgence spurred by the global demand for critical minerals and the sector's shift to embrace the green and digital transitions. Mining companies are increasingly advancing innovation and supporting sustainability initiatives. For one, firms are investing in greener extraction methods, adopting circular economy principles and partnering with universities on research and innovation. These actions can drive innovation in regional economies, with additional potential spillover benefits to other sectors, such as environmental management, advanced manufacturing, robotics and data analytics. Furthermore, the industry is central to the push towards renewable energy systems. For example, it supplies the rare earth minerals central to the production of the latest zero-carbon renewable energy sources, such as electric vehicles and storage batteries, solar panels and wind turbines. The sector will increasingly gain in importance, as demand for rare earth minerals is expected to grow 400 to 600% over the next decade (Cho, 2023[3]).

Yet, the sector's shift towards advanced technologies, such as digitalisation and automation, and the push for environmental sustainability in mining operations also bring significant employment and skills challenges. While manual labour—particularly equipment inspection and on-the-ground maintenance—remains important, demand for traditional mining occupations is expected to continue to decline. For example, in the United States, employment in mining fell by almost 60% between 1980 and 2015, mostly due to the decline of coal mining, and almost 47% of jobs in the energy, utilities and mining industries in North America are at high risk of automation by 2030 (Lo, 2017[4]; Sherif, 2023[5]). Some regions will be particularly impacted, even as the overall employment gains may be net positive. For example, the use of automation technologies in mining is projected to add AUD 74 billion to the Australian economy and create over 80 000 new jobs by 2030, given effective management of domestic supply chain goods and services. These new jobs would be due to new roles in the mining firms, such as programming, analytics, and maintenance, and from increased demand in the supply chain and wider economy (AlphaBeta, 2019[6]). At the same time, Australia's Queensland region is expected to see around 10 000 coal mining jobs replaced in the near future, approximately 40% of the coal mining workforce (Fleming-Muñoz et al., 2019[7]).

A growing geographic mismatch between the demand for advanced skills and the availability of qualified workers is emerging as a challenge in the mining industry. As firms introduce remote-controlled machinery, autonomous vehicles, data-driven planning tools, and environmental planning, it leads to new, complex and rapidly evolving skill requirements. For instance, next-generation mines like

Rio Tinto's Smart Mine in Gudai-Darri, Australia, leverage autonomous haulage systems and advanced analytics, necessitating expertise in data science and remote operations management and leading to the creation of almost 4 000 jobs (Hamilton et al., 2024[8]). Yet these advanced technologies demand a workforce skilled in fields such as robotics, AI, and predictive analytics—talent pools that are not always readily available in traditional rural mining regions. The push for environmentally sustainable mining operations also creates demand for new roles, such as environmental compliance officers, renewable energy integration specialists, and carbon footprint analysts. These roles require expertise in areas like environmental science, renewable energy systems, and lifecycle assessment. Mining regions, often located in remote areas, must, therefore, compete with more attractive urban centres to secure the talent needed for the sector's transition.

In light of these advancements, mining faces persistent skills shortages and mismatches between industry needs and educational offerings. A recent cross-national industry survey found that 86% of mining executives reported greater difficulty in recruiting and retaining talent compared to two years ago. Seven out of ten leaders in mining identified talent shortages as a barrier to meeting production targets and strategic goals (McKinsey and Company, 2023[9]). In Australia, there were over 10 000 vacancies in the mining sector, representing almost 3% of all vacancies or about 3% of the mining workforce (Australian Department of Industry, Science and Resources, 2023[10]). Workers to fill emerging roles in environmental management are often scarce in regions where mining has historically relied on traditional skills. These shortages underscore the urgency of aligning workforce development with the sector's evolving needs.

In general, four interrelated factors contribute to the challenges of attracting, retaining and training a skilled mining workforce in local economies. While each factor applies broadly to the mining sector, the degree to which each factor is relevant at the local level will depend on particular regional characteristics.

1. *Shortage of people*: Ageing demographics in many rural mining regions exacerbate workforce shortages. The current mining workforce tends to be older and is expected to retire, and there are difficulties in recruiting new entrants, including women, youth, Indigenous populations, and foreigners who could reinvigorate the talent pool.

2. *Shortage of skills*: Education and training systems often struggle to keep pace with the increasingly high-tech nature of mining. Universities and vocational institutions may not offer the specialised modules or apprenticeships that modern mine employees require.

3. *Job not attractive*: Despite the lure of competitive salaries, the mining sector competes with technology firms, engineering companies, and other high-growth industries that provide both flexibility and strong career progression. Negative perceptions of mining—ranging from environmental concerns to perceptions of the sector as hazardous or physically demanding—can deter young professionals.

4. *Place not attractive*: Mines are frequently located in remote or rural areas that lack the amenities of urban centres. Housing shortages, limited access to services and healthcare, fewer educational opportunities for families, and limited diversity of jobs for two-earner households can deter potential workers from relocating.

Availability

Shortage of people	Shortage of skills
Job not attractive	Place not attractive

Attractiveness

Source: OECD elaboration.

The following sections examine the evolving profile of the mining workforce and identify priority issues underpinning current labour shortages. It then explores policy measures and industry-led initiatives to bring in different groups of workers, bridge the skills gap, transform the sector's reputation, and enhance regional attractiveness. Through real-world examples and best practices, the paper aims to inform strategies that promote mining as a viable, sustainable, and innovative source of employment and economic growth. The paper also builds on findings from the OECD Mining Regions and Cities Initiative, which has been supporting the design of effective policy in OECD mining regions with tailored case studies and global events since 2017.[1]

2 Regional trends of the mining sector and its workforce

The contribution of the mining sector to economic activity and the local workforce is significant in many OECD regions. In resource-rich regions, such as Antofagasta in Chile, almost 70% of the region's GDP comes from the mining sector (Figure 2.1). The mining sector's share of regional GDP is also large, standing at more than 40% in Nunavut (Canada) and Atacama (Chile). In Western Australia, more than 35% of all regional revenue in sales and income comes from mining and its support services. Mining also represents 10 to 20% of the regional economy in multiple regions in the United States (North Dakota, Wyoming, New Mexico, Oklahoma), Sweden (Upper Norrland, East Central Sweden), and Finland (Kainuu, Lapland). These figures are likely underestimations of the full contribution that the sector provides to the local economy as it does not consider spillovers to related services that support the sector and its employees. As global demand for critical minerals surges, propelled by the energy transition, the mining sector may become even more prominent for regional economies.

In addition, these regions are typically located in rural and often remote areas. For example, the OECD developed a mining regions toolkit that examines the well-being of 50 OECD regions selected due to their high specialisation in mining activity relative to their respective countries. Among these regions, 92% of them are classified as rural regions (non-metropolitan) and 44% of which are rural and remote areas (OECD, 2023[11]).

Yet, mining and its role in regional economies have undergone major shifts in recent decades, shaped by global demand fluctuations, technological advancements, and evolving sustainability priorities. Historically, declining commodity prices, shifting energy policies, and automation contributed to significant job losses, particularly in coal mining. In the United States, for instance, employment in coal mining fell by nearly 60% between 1980 and 2015 (Lo, 2017[4]). Many regions historically dependent on coal, such as parts of Germany and the United Kingdom, underwent long-term economic restructuring, with some successfully diversifying while others faced persistent economic stagnation (Ruppert Bulmer et al., 2021[12]; Jermain et al., 2022[13]). The perception of mining as an industry in decline also contributed to a weakened talent pipeline, as fewer young workers pursued mining-related education and training, limiting the sector's ability to meet rising labour demand today.

Figure 2.1. Where mining exists, it is a large share of regional economies

Share of value-added, GDP or sales and income of the mining sector, depending on availability
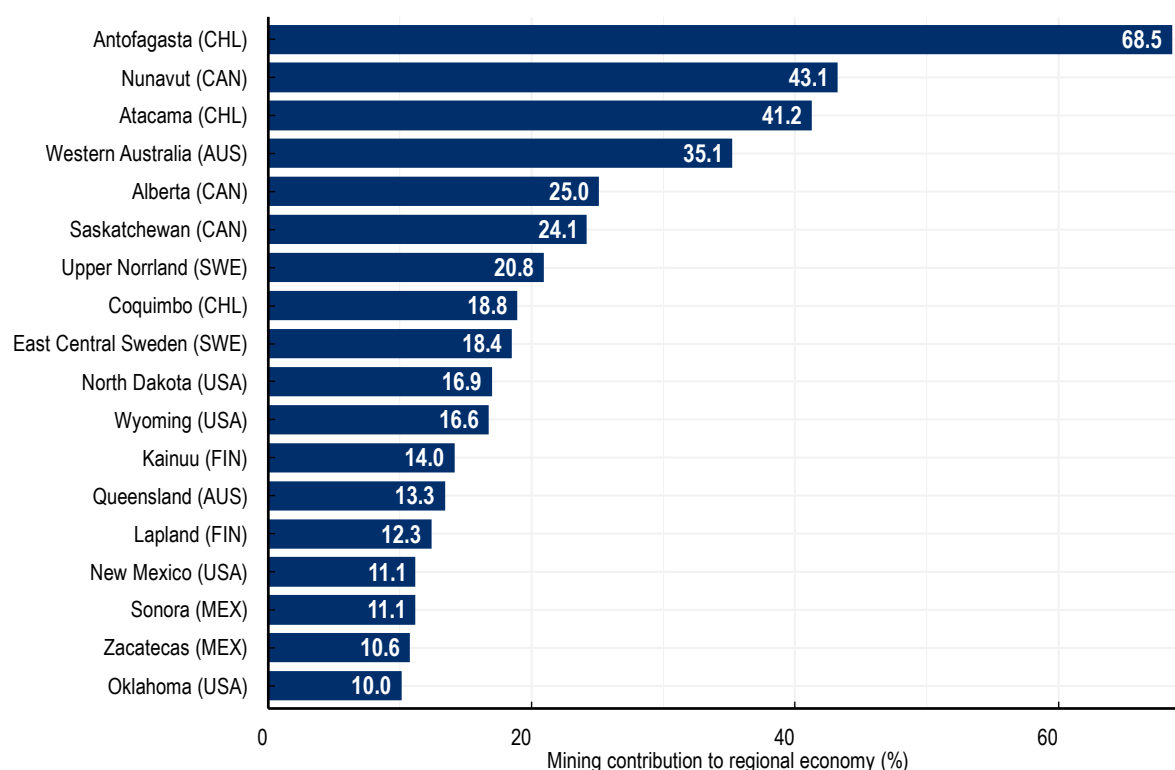
Note: The figure presents the mining sector's contribution to the regional economy in 2023 or the latest available year. Mining contribution to the regional economy refers to different statistics, depending on data availability. As such, comparisons between countries should be avoided. For Australia, it refers to the share of sales and income of mining out of all regional revenue. It reflects the market presence of mining in the regional economy but does not take into account intermediate outputs and may overstate the sector's economic contribution. For Germany, Finland and the United Kingdom, it refers to the share of value-added of the mining sector to the regional economy. Thus, it represents the sector's productivity, ignoring government taxes or subsidies. For all other countries (Canada, Chile, Mexico, Norway, Sweden, and the United States), it refers to the share of GDP of mining in the region. It represents the mining sector's contribution to final goods and services produced in the region, excluding intermediary outputs. The last available year refers to 2022 for the United Kingdom and 2021 for Finland, Germany, and Mexico. The figure presents select top regions that are part of the OECD Benchmark of Mining Regions and Cities and where mining contributes at least 10% to the regional economy. The data refers to TL-2 regions, except for Finland and Norway, where the data is at the TL-3 level.
Source: OECD elaboration using the Australian Bureau of Statistics, Statistics Canada, National Bank of Chile, Statistics Denmark, Statistics Finland, German Federal Statistical Office, Mexican National Institute of Statistics and Geography, Statistics Norway, Statistics Sweden, United Kingdom Office for National Statistics, United States Bureau of Economic Analysis.

The resurgence of demand for critical minerals is revitalising the mining industry and driving policy priorities. The global push for renewable energy and clean technologies is driving unprecedented demand for materials such as lithium, cobalt, and rare earth elements—key inputs for electric vehicles, solar panels, and battery storage. Demand for rare earth minerals is expected to grow by 400–600% over the next decade (Cho, 2023[3]). In response to this growing demand, many OECD governments have passed legislation aimed at strengthening domestic supply chains. The European Union adopted the Critical Raw Materials Act, and Canada and Australia each launched a Critical Minerals Strategy to strengthen supply chains and attract investment (Council of the EU, 2023[14]; Government of Canada, 2022[15]; Australian Department of Industry, Science and Resources, 2023[10]).

These policy shifts are reshaping regional economic trajectories, creating new opportunities in mineral-rich regions. Unlike coal, which continues to face structural decline due to decarbonisation efforts, critical minerals mining is rapidly expanding, with some regions seeing the reopening of previously closed mines. For example, in Sweden, previously inactive mining sites are being revived to secure domestic access to critical minerals (Northam, 2023[16]). Similarly, regions like Western Australia and Québec (Canada) are experiencing rapid growth in mining activity due to their strategic reserves of lithium and nickel (Government of Western Australia, 2023[17]; Burton and Thomas, 2024[18]; Sandell-Hay, 2022[19]). However, this revival is not uniform. Some mining regions remain in long-term decline, particularly those historically reliant on coal, such as communities in the South Yorkshire region (United Kingdom), while others have fully transitioned to alternative industries, such as the Ruhr region in Western Germany (Bowen et al., 2020[20]; World Resources Institute, 2021[21]; Jermain et al., 2022[13]; BBC, 2024[22]). It is important to balance new employment opportunities with the well-being of mining regions by supporting diversified economies while limiting negative environmental externalities (OECD, 2023[1]; OECD, 2023[23]).

Simultaneously, the mining industry is embracing innovation, leading to fundamental shifts that are redefining both the nature of work and the skills required. Advanced technologies such as autonomous vehicles, data analytics, and remote-controlled processes are reshaping operational processes and driving demand for new skills across the workforce (AlphaBeta, 2019[6]; Mining Technology, 2024[24]). At the same time, heightened environmental and social expectations are prompting mining companies to adopt more sustainable practices, requiring expertise in areas such as emissions reduction, biodiversity management, and community engagement (IEA, 2022[25]). This leads to a need for diverse skill sets spanning from traditional roles to emerging skill needs and occupations. Furthermore, negative perceptions of the industry, competition from other sectors, and demographic constraints in often remote mining regions add to these recruitment difficulties.

Yet, in many places, mining companies already struggle to fill available vacancies. Figure 2.2 presents the relative labour market tightness rate, defined as the share of vacancies among employed persons in the mining industry compared to the average industry in the same region. In 2022, job vacancy rates in mining were up to three times the average industry in Queensland (Australia) and over two times the average industry in New South Wales and Western Australia, suggesting significant labour market tightness in these regions. In multiple regions in the United States (Kansas, Texas, Oklahoma, North Dakota) and Canadian provinces (Newfoundland and Labrador, Saskatchewan, Alberta), mining job vacancy rates are about half of the average across all industries in the region, indicating skill shortages, although less than other sectors in the region. This is likely due to the under-representation of mining, a traditionally manual industry, in the data on online job vacancies on which these findings depend. Differences across countries can also likely be attributed to different coverage rates (Tsvetkova et al., 2024[26]; Vermeulen and Gutierrez Amaros, 2024[27]). Despite this possible sample bias, job vacancy rates are nonetheless high for the mining industry in many regions. Thus, these industry shifts create new opportunities and expose pressing workforce challenges, especially in remote mining regions.

Figure 2.2. Job vacancy rates in mining vary from one-tenth to over three times tighter than the average industry in the same region
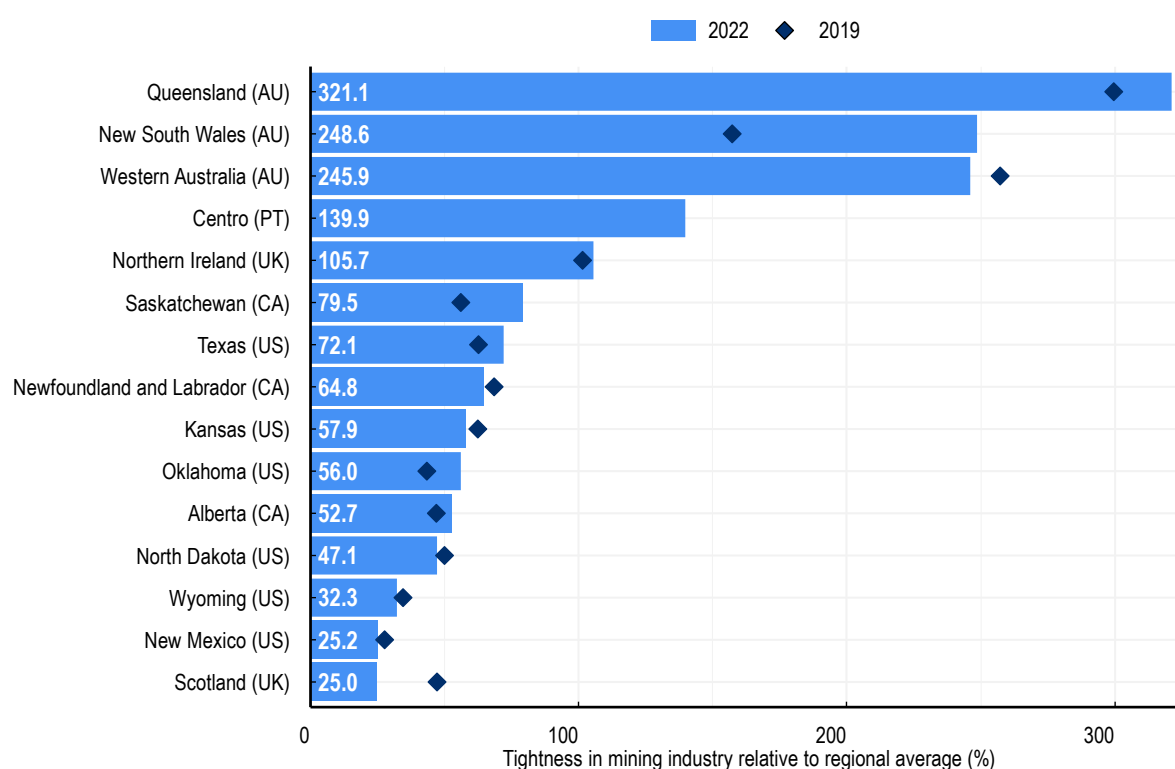
Note: Relative labour market tightness by industry is calculated at the regional level as the number of vacancies over employment for the mining region in a region, divided by the regional labour market tightness average. Industries are classified according to broad industries (i.e., the highest level) of the respective industry classification, namely NAICS in the US, NACE in the EU, UK SIC in the UK and ANZSIC in Australia. The figure presents select TL-2 regions where there is at least one sub-region (TL-3) that is part of the OECD Benchmark of Mining Regions and Cities or regions where mining represents at least 5% of total employment and there are at least 60 mining vacancies in that year.
Source: OECD elaboration using Lightcast; EU-LFS, UK-LFS, Bureau of Labour Statistics (USA), and Australian Bureau of Statistics.

Key features of the mining workforce

Mining is a globally important sector, yet employment can be highly localised, accounting for a significant share of employment in resource-rich regions. For instance, in Australia, the industry employs over 290 000 people (around 2% of the national workforce), but this figure rises substantially in regions such as the Pilbara region of Western Australia, where mining accounts for more than 30 000 jobs, or over half of the local workforce (Pilbara Development Commission, 2025[28]; Australian Department of Industry, Science and Resources, 2023[10]). Figure 2.3 presents the region with the highest share of employment in the mining industry among TL-2 regions in OECD countries with available data in 2022. Although TL-2 regions tend to be quite large, the mining industry's outsized impact on regional employment is still evident: In Western Australia, it employs almost one-in-ten workers; in Western Norway, it is one-in-thirteen workers; in Alberta (Canada) and Wyoming (United States), it is one-in-fifteen workers; and in Silesia (Poland), it is one-in-twenty workers. Furthermore, even where it accounts for a modest percentage of overall employment, mining often underpins broader regional labour markets via supply chains and ancillary services, such that its full impact on local economies and employment is likely underestimated.

Figure 2.3. Mining employment is highly localised, accounting for almost 10% of jobs in some OECD regions
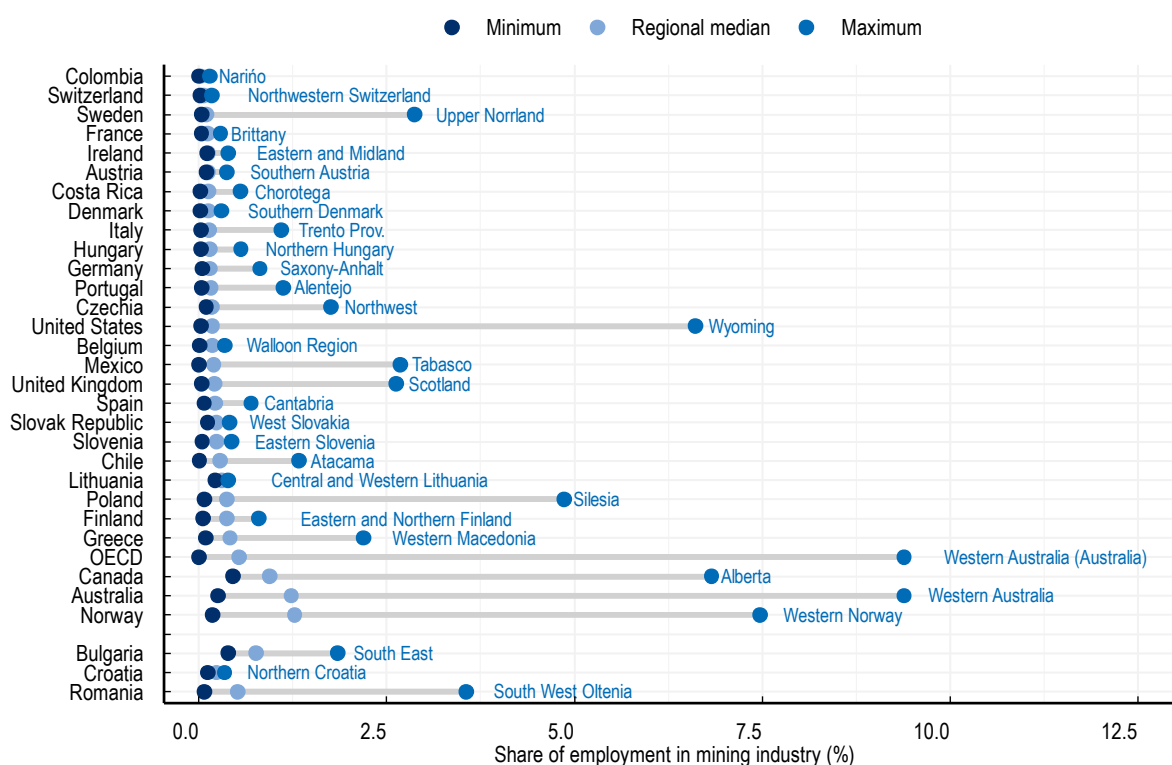
Note: The figure shows the regional dispersion (highest, lowest and median value) in the share of employment in the mining industry in 2022. The sample is all TL-2 regions in countries (including the OECD accession countries of Bulgaria, Croatia and Romania) with available data. The share of jobs in the mining industry is defined as the number of persons employed in mining out of all employed persons.
Source: OECD calculations based on national labour force surveys for the European Union, Canada, Chile, Colombia, Costa Rica, Mexico, the United States and the United Kingdom.

Future demand is expected to remain robust, particularly for critical minerals used in electric vehicle batteries and renewable-energy infrastructure. For example, Canada's mining employment nearly doubled in 2022 alone, and Australia's emerging battery industry is expected to support up to 61 400 direct jobs by 2030 (Mining Industry Human Resources Council, 2024[29]; Australian Department of Industry, Science and Resources, 2023[10]). Technological developments are expected to generate further opportunities. In one study, although automation may displace some 40 000 frontline roles, such as truck drivers, dozer operators, and excavator operators, these forecasted job losses can be offset by gains in 69 000 jobs in the associated supply chains and 53 000 new jobs in the wider economy (METS Ignited and NERA Industry Growth Centres, 2019[30]).

Mining encompasses a broad array of occupations, from equipment operators and geologists to process engineers and environmental specialists. Traditionally, roles focused on physical extraction (e.g. haul-truck drivers and drillers), but expanding automation is also generating demand for higher-skilled positions, including data analysts, IT specialists, and autonomous operations controllers (Mining and Automotive Skills Alliance, 2024[31]; Shell, 2023[32]). In Europe, for example, management and office-based functions accounted for much of the recent hiring surge in mining, reflecting the need for personnel to oversee sophisticated, remote-controlled processes (Ross, 2023[33]).

Employment prospects in engineering, electronics, cybersecurity, and mechanical maintenance are also increasing due to the green and digital transition. In Australia, key occupations in the mining

industry, such as metal fitters, electricians, engineers, and geologists, have experienced significant growth in recruitment activity (Mining and Automotive Skills Alliance, 2024[31]). Beyond operational roles, there is a growing emphasis on "soft" and cross-functional skills, such as change management, stakeholder engagement, creativity, and strategic planning, to address evolving ESG (environmental, social, and governance) considerations and community relations (Mining Industry Human Resources Council, 2024[29]; OECD, forthcoming[34]).

Mining workforces tend to be characterised by relatively high wages and skilled occupations. In Chile, mining salaries are twice the national average, and in Canada, recent data shows rapidly increasing wages in mining—an annualised growth rate of over 10% between 2021 and 2022, though wage volatility remains high (Mining Industry Human Resources Council, 2024[29]; Fernandez-Stark, Couto and Bamber, 2019[35]). Among OECD countries with available data, almost 64% of employees in the mining industry are employed in occupations classified as medium-skilled, such as clerks, craft workers, plant and machine operators and assemblers; and 35% in high-skilled occupations, e.g. managerial, professional, technical and associated professional occupations. Furthermore, over 90% of the mining workforce has at least post-secondary, non-tertiary education, with almost one-third having completed college (Figure 2.4).

The mining sector grapples with an ageing workforce, as a sizable share of experienced employees approaches retirement, a challenge intensified by ageing populations in remote mining regions. Across OECD countries, over 72% of the mining workforce is over 35 years old (Figure 2.4). This trend is compounded by declining enrolments in mining-related higher education programmes, such as mining engineering, which has fallen by 63% in Australia since 2014 and 39% in the United States since 2016 (McKinsey and Company, 2023[9]). These demographic pressures are particularly acute in regions where commodity cycles historically prompted periodic layoffs, leading to a depleted local talent pipeline. In Chile, only 30% of new hires in 2022 were under the age of 30, despite targeted measures to attract younger workers (Mining Council Team, 2024[36])

Women remain under-represented in the mining workforce, accounting for less than 17% of employees among OECD countries (Figure 2.4). Globally, women account for only 15% of mining employees (International Institute for Sustainable Development, 2023[37]). In Australia, women account for roughly 18% of mining workers, placing the sector among the lowest for female participation in the national economy, ahead only of the construction sector, which has the smallest share of women (Australian Department of Industry, Science and Resources, 2023[10]).

The distribution of women across occupations in mining is uneven. Administrative and clerical roles tend to have a relatively higher female share, whereas machine operations, heavy equipment driving, and technical positions remain overwhelmingly male-dominated. Despite incremental gains in recent years, women's representation in senior leadership and board positions remains limited, with female C-suite participation in many mining companies at only 12% (McKinsey and Company, 2023[38]).

Part-time and casual employment is also more prevalent among women, and the gender wage gap is high. One study found that 67% of women in mining held part-time roles, compared with 16% in full-time positions (International Institute for Sustainable Development, 2022[39]). Geographically, female employees are more likely to work in urban-based offices, such as company headquarters in major cities, rather than remote mine sites (Fernandez-Stark, Couto and Bamber, 2019[35]). Wage disparities persist as well, with reports suggesting that the sector's pay gap falls in the 15-25% range, meaning that for every dollar men earn, women earn about 0.75-0.85 cents (International Institute for Sustainable Development, 2022[39]; Workplace Gender Equality Agency, 2023[40]; McKinsey and Company, 2021[41]).

Figure 2.4. The mining workforce is mainly made up of older, male workers and medium education and job skill levels
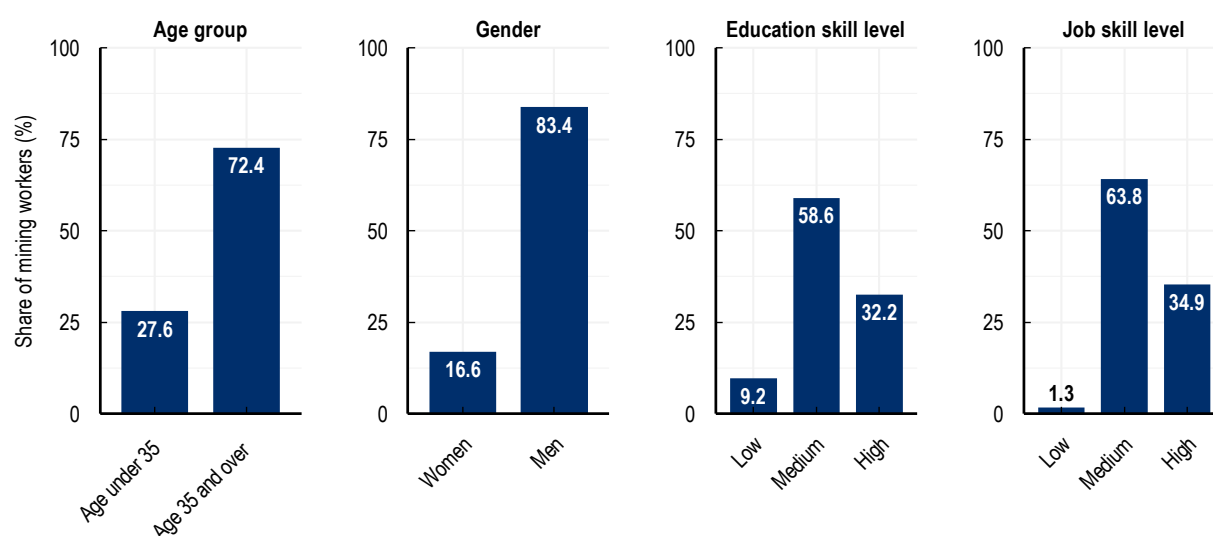
Note: The figure presents the weighted share of workers employed in the mining industry by age group, gender, educational skill level and job skill level for the year 2022 or latest available year. For Korea, the latest available year is 2021. Educational skill level is defined using ISCED educational attainment levels. Low skill is defined using ISCED codes as workers with at least a lower secondary education (ISCED 0-2), medium skill is those workers up to post-secondary, non-tertiary education (ISCED 3-4), and high skill is those workers with tertiary education (ISCED 5-8). Job skill level is defined using ISCO occupational categories. Low-skilled correspond to jobs in sales and services and unskilled occupations (ISCO 5 and 9), medium-skilled workers hold jobs as clerks, craft workers, plant and machine operators and assemblers (ISCO 4, 7 and 8), and high-skilled workers are those who have jobs in managerial, professional, technical and associated professional occupations (ISCO 1, 2 and 3). The definition of skill is based on the educational level thought to be required of an occupation and does not consider skills not related to educational level.
Source: OECD calculations based on national labour force surveys for the European Union, Canada, Chile, Colombia, Costa Rica, Korea, Mexico, the United States and the United Kingdom.

Mining operations are typically located in remote or rural areas with sometimes limited local infrastructure. For example, in the northern regions of Australia, rental vacancy rates as low as 0.6–1.0% highlight the difficulty of finding suitable local accommodation. Similarly, in Chile, where Antofagasta produces over half the country's copper but struggles to retain local labour, many high-skilled workers commute from the capital, Santiago, resulting in a fragmented mining labour market (Mining Council Team, 2024[36]; Atienza, Lufin and Soto, 2021[42]).

While remote mining operations can boost local economies through job multipliers in sectors such as transport and accommodation, they also rely substantially on subcontracted and fly-in fly-out labour (Tano, Pettersson and Stjernström, 2016[43]; Petrova and Marinova, 2013[44]). Firms commonly outsource functions such as equipment maintenance, engineering services, and logistics, which offer quick access to expertise and flexibility for fluctuating commodity cycles (Fleming and Measham, 2014[2]; Shell, 2023[32]; Baatartogtokh, Dunbar and van Zyl, 2018[45]). In Chile's large-scale mining sector, the proportion of subcontracted workers has risen dramatically—from almost one in eight in 1990 to over two-thirds by 2009, resulting in a contractor-to-direct employee ratio of about 2.1 to 1 (Mining Council Team, 2024[36]; Atienza, Lufin and Soto, 2021[42]). In Australia, contractors and temporary hires account for up to 60% of the workforce in some mining companies and almost the entire workforce on some sites (Hepworth, 2020[46]). Thus, while mining supports significant economic activity in resource-rich regions, a large share of employment is provided through external contractors rather than direct local hiring or worker relocations.

3 Priority issues shaping the mining labour market

In this evolving landscape, it is important to support remote regions and local populations so that they benefit, rather than being left behind, from the emerging transitions in the mining industry. Bringing new workers into mining (such as women, youth, and under-represented communities) is also widely viewed as a strategic imperative to expand the dwindling talent pool and for long-term competitiveness. This section highlights four policy priorities to strengthen workforce development: (i) addressing demographic challenges, (ii) bridging the skills gap, (iii) transforming perceptions, and (iv) building more attractive mining regions.

Addressing demographic challenges of mining regions

The mining sector's workforce is predominantly older and male, and many mining regions face ageing populations, aspects limiting the sector's ability to attract and retain new talent. This skewed demographic profile not only limits the talent pool but also constrains innovation. Low enrolment rates in mining-related studies among women and youth add to the challenge. In remote regions where local populations are shrinking, and mining is a cornerstone of the local economy, this issue is particularly acute, further exacerbating labour shortages and impeding sustainable growth (OECD, 2023[11]). Furthermore, many mining regions have large Indigenous populations that can be better integrated to profit from employment opportunities in the sector (OECD, forthcoming[47]).

Broadening the workforce is not only important for renewing a shrinking talent pool; workplaces with people of different profiles also tend to achieve better outcomes. Research shows that companies in the top quartile of racial representation are 36% more likely to outperform their peers financially, and those with varied gender representation in leadership are 25% more likely to exceed performance benchmarks. Mining crews with a broad mix of backgrounds also experience a 67% lower injury rate than their more homogenous counterparts (McKinsey and Company, 2023[38]). Such advantages are important to a modernising sector shifting towards technology-enabled and sustainable mining practices. Tapping into the talent of women, young people, Indigenous populations, and even foreign workers can foster a more resilient and agile workforce.

Efforts to attract different types of talent face several challenges related to barriers that reinforce the status quo. Deep-rooted perceptions of mining as a physically demanding and inherently masculine field discourage many, especially women and young people, from pursuing careers in the sector (McKinsey and Company, 2021[41]). The lack of effective outreach programmes and visible role models reinforces this perception, such that the industry struggles to communicate the tangible benefits of mining careers. Reports of widespread bullying, sexism, and harassment further discourage potential recruits and contribute to higher turnover among women and Indigenous workers. For instance, one study finds that nearly half of employees at a large mining company reported experiencing bullying, and incidents of harassment are disproportionately high among female and Indigenous workers (Elizabeth Broderick & Co, 2022[48]). In addition to barriers of workplace discrimination and educational training gaps, Indigenous populations also suffer from a lack of culturally appropriate training and support services (Bond and Quinlan, 2018[49]).

The workplace conditions—often shaped by the historical norms of remote, rugged mine sites—can be unaccommodating for women who may need more flexible working arrangements or family-friendly policies. A 2019 report from the Western Australian Department of Communities found that 57% of women identified poor childcare access in remote regions as a major barrier, and family responsibilities are one of the main reasons women cite for leaving their mining jobs. Furthermore, 70–80% of female applicants are unwilling or unable to commit to multi-day shifts in remote locations, and 69% of female employees cite distance and family separation as important deterrents (International Institute for Sustainable Development, 2022[39]).

Digital transformation can erode some of these traditional barriers by shifting a significant portion of work from hazardous rural mine sites to urban-based control centres. Remote-controlled equipment and digital interfaces open up opportunities for workers, especially women, to excel in roles that rely on decision-making under stress and multitasking (Mather and Lighthall, 2012[50]). Even as technology opens up opportunities, women remain under-represented in the STEM pipeline. Globally, women account for only 14% of STEM graduates, this figure falling below the average in key mining countries, such as Australia (10%), Canada (12%), Chile (7%), South Africa (13%), and the United States (10%) (Fernandez-Stark, Couto and Bamber, 2019[35]). Thus, while automation can reduce some structural barriers associated with mining jobs, it is important that under-represented groups, such as women, youth and the Indigenous community, are equipped with the education and skills to profit from these opportunities.

Without a concerted effort to broaden the workforce profile, mining companies face a depleting talent pool. This risks perpetuating a cycle of recruitment difficulties that hampers technological adoption and productivity gains. Such efforts can help shift entrenched perceptions, making mining a more attractive career option for women, youth, Indigenous people, and other under-represented groups.

Bridging the skills gap in a rapidly evolving sector

The mining sector is facing a pervasive shortage of skilled workers. This challenge is intensifying as the industry rapidly transforms through digitalisation, automation, and a stronger focus on sustainability. High-demand roles, including mining engineers, geological, geotechnical and processing engineers, geologists, hydrogeologists, and metallurgists, remain in critically short supply. Educational pathways must adapt to keep pace with the evolving skill needs of the industry as it adapts to the green and digital transitions (McKinsey and Company, 2023[9]; Australian Department of Industry, Science and Resources, 2023[10]).

Mining operations are increasingly adopting advanced automation and digital technologies. Recent surveys indicate that 73% of mining executives view robotics and automation as the most significant drivers of innovation over the next 15 years (Paredes and Fleming-Muñoz, 2021[51]). The sector now requires a workforce proficient not only in traditional mining techniques but also in advanced digital competencies. Workers with expertise in areas such as data analytics, systems integration, and real-time digital monitoring will be needed to fully exploit innovations that promise to cut costs, reduce emissions and improve productivity (Fernandez-Stark, Couto and Bamber, 2019[35]; Shell, 2023[32]). For instance, digital automation is forecast to add over USD 50 billion in value to the Australian mining industry by 2030 by enhancing operational efficiency and reducing costs (METS Ignited and NERA Industry Growth Centres, 2019[30]).

Mining companies are also adapting under increasing pressure to reduce and manage their environmental footprint across the full life cycle of a mine. To meet net-zero targets, mining value chains will need to reduce absolute emissions by as much as 90% from 2020 levels (International Finance Corporation, 2021[52]). Meeting this target will require the sector to change its operations and expand its workforce. For example, the sector will require workers skilled in digital automation technologies, such as carbon accounting software that provides real-time emissions data, which streamlines operations and lowers energy consumption (Shell, 2023[32]).

New roles will be created, such as specialists in advanced water and waste management and experts in mine closure planning. In parallel, the sector's transition to sustainable operations calls for transversal skills since it requires mining engineers and process engineers to integrate renewable energy solutions, conduct emissions monitoring, and manage sustainable mine closure practices, blending traditional engineering expertise with modern environmental science (Fernandez-Stark, Couto and Bamber, 2019[35]; Mining Industry Human Resources Council, 2024[29])

Addressing these skill gaps is challenging, especially in remote regions where it can be difficult for institutional capacity to keep up with the rapid developments in the sector. Educational institutions often struggle to update their curricula to keep pace with industry innovations, further exacerbated by declining enrolments in mining engineering courses (Shell, 2023[32]). For instance, while traditional mining courses have long been available in tertiary education, institutions must now also offer modules on digital data management, automation controls, or sustainable practices. Bureaucratic hurdles in developing new courses and licensing processes further slow the introduction of updated training programmes, compounded by the need to collaborate between actors with different capacities and priorities. Additionally, many vocational and tertiary training programmes are located in urban centres, making them less accessible to potential workers from remote mining communities (OECD, 2021[53]; OECD, 2023[1]; Australian Department of Industry, Science and Resources, 2023[10]).

Together, these challenges underscore the need for more agile and integrated workforce development strategies that align skills supply to the sector's rapidly evolving technological and sustainability demands. The mining sector's potential to generate downstream economic benefits is well recognised: For every mining job created, the Minerals Council of Australia estimates that an additional six jobs are generated throughout the supply chain (Minerals Council of Australia, 2024[54]). Yet, without a concerted effort to realign educational programmes with emerging skills needs, these multiplier effects may be undermined by a persistent shortage of adequately trained personnel.

Transforming perceptions to increase the mining sector's appeal

The mining sector—often seen as a dirty, hazardous industry with limited prospects for career progression—struggles with changing its entrenched negative image. This perception is particularly pervasive among younger generations. For example, seven out of ten young people would not consider a career in mining, and nearly three-quarters believe that mining does more harm than good to society (McKinsey and Company, 2023[9]; Mining and Automotive Skills Alliance, 2024[31]). Transforming the sector's negative image, particularly among youth, is therefore important to attract and retain the advanced transversal skills needed for its ongoing digital and green transitions.

These adverse perceptions are compounded by inherent challenges in the mining career path. The industry is frequently criticised for its harsh, physically demanding working conditions, limited career progression beyond middle management, and an overall lack of inspiring professional development beyond standard occupational training (McKinsey and Company, 2023[9]). This situation is particularly acute when competing with other sectors that offer more attractive working conditions and opportunities, especially for candidates with transversal advanced skills in IT and automation. Macro trends, including a growing expectation among Generation Z for purpose at work and a disconnect between what workers need and what managers provide, have only deepened these challenges (McKinsey and Company, 2023[9]).

A lack of action to address past failures and insufficient communication regarding modern mining practices further compounds recruitment challenges. For example, the failure to rehabilitate past mining sites in Central Greece leaves residents with a negative view of the sector (OECD, 2025[55]). Many potential recruits are unaware of the evolving nature of mining careers, which now include roles in automation, digitalisation, and sustainable operations. In one survey, nearly 75% of Generation Z

respondents felt that mining does more harm than good, 56% preferred a smaller mining industry, and only 27% recognised that Australia also mines lithium—a key mineral for a decarbonised future. In addition, a significant proportion of young people report that they have no one with whom to discuss mining careers. For example, 76% of respondents in Victoria indicated they do not speak with anyone about such opportunities, compared with lower figures in mining-intensive states like Western Australia (Mining and Automotive Skills Alliance, 2024[56]; Australian Department of Industry, Science and Resources, 2023[10]). Such gaps in awareness highlight the challenges in conveying the diverse and evolving nature of modern mining careers.

At the same time, there are tangible strengths that the sector can leverage, such as mining communities themselves. For one, perceptions of mining are sometimes more positive in longstanding mining communities. In Australia, for instance, 85% of young people from Western Australia, a major mining region, consider mining to be extremely or very important to the national economy, in contrast to only 57% from Victoria (Mining and Automotive Skills Alliance, 2024[56]). Such regional differences suggest that local factors, including exposure to mining operations and economic reliance on the sector, can influence public opinion. Competitive remuneration, the formation of tight-knit teams due to the remote nature of sites, and the potential for positive ESG impacts are also notable advantages. For instance, 30% of diverse talent cite a positive contribution to ESG as a reason to join the industry, compared with 14% among nondiverse talent (McKinsey and Company, 2023[38]).

Transforming perceptions in the mining sector requires a concerted effort to improve and better communicate the modern, innovative, and sustainable nature of today's mining operations and address past failures. Overcoming the deep-seated negative views will demand not only improvements in working conditions and career progression but also a robust, targeted campaign to highlight the industry's commitment to ESG and its potential to foster regional development. Without such coordinated action, the gap between the sector's economic potential and its public image will continue to impede its ability to attract the skilled workforce it needs.

Enhancing the appeal of mining regions to attract workers

The mining industry is inherently local, yet many mining communities are situated in remote areas that often lack essential services and attractive infrastructure that modern workers require. The quality of life in a community is an important factor in attracting and retaining workers and families, even balancing salary considerations. Access to services, affordable housing, and recreation can be determinants of people's decisions to move to a place. In these areas, the limited availability of affordable housing, quality healthcare, educational facilities, and recreational amenities not only deters new talent but also jeopardises the retention of existing workers and their families. Moreover, limited economic diversification, partly due to the small scale of many mining communities, can make it difficult for dual-earner families to find suitable employment, reducing the long-term appeal of these communities.

A pressing issue in these communities is the sometimes persistent housing shortage driven by the influx of mining workers during boom periods. In Western Australia's Pilbara region, rents increased by more than 120% over five years in two of the region's biggest mining towns, making it difficult for both new and existing residents to secure affordable accommodation (McLean, 2024[57]). Such housing shortages and price surges not only strain local workers but also make it less viable for non-mining professionals, such as teachers and healthcare workers, to remain in the region, further limiting access to essential services. The transient nature of the mining workforce, particularly with fly-in fly-out arrangements, exacerbates this challenge, as short-term housing needs often take precedence over long-term community investment.

Beyond housing, mining communities frequently struggle with underdeveloped infrastructure and services, a challenge common to many rural areas but made worse by the cyclical nature of mining

(OECD, 2023[11]; OECD, 2022[58]). During boom periods, rapid population growth outpaces the development of essential services such as healthcare, education, and recreational facilities, putting strain on the community (MiningWatch Canada, 2001[59]; Meggersee and Guvuriro, 2023[60]). Moreover, the reliance on fly-in fly-out workforces, while addressing immediate labour shortages, often results in weaker community cohesion and underinvestment in local infrastructure, as workers spend limited time in the community and contribute minimally to the local economy (Marais, 2023[61]).

This geographic isolation is a major barrier to recruiting workers with transversal skills who are in high demand across multiple industries. Professionals with advanced skills in automation and digital solutions or environmental management often have ample opportunities in urban centres where state-of-the-art facilities, flexible working arrangements, and vibrant communities can match their career expectations. Unlike traditional mining roles, these professionals are sought across industries, meaning that salary incentives alone are often insufficient to attract them to remote locations. Thus, remote mining regions struggle to compete not only on salary but also on quality of life.

Moreover, the lack of local higher education institutions or vocational training programmes in mining regions limits the development of a local talent pipeline. When higher education and vocational training programmes are based in urban centres, potential workers in remote areas also often have fewer opportunities to access the education needed to work in modern mining operations. If local workplaces exclusively use a regional language, language barriers can further limit the attraction of international or diverse talent.

Efforts to enhance regional appeal, therefore, must address these quality-of-life issues while learning from past transitions towards a long-term vision beyond the closure of the mine. Lessons from the coal phase-out in Poland underscore the necessity for comprehensive, locally tailored strategies. These transitions required not only generous compensation and retraining programmes but also significant investments in infrastructure and economic diversification to prevent long-term regional decline (Ruppert Bulmer et al., 2021[62]; Jermain et al., 2022[13]). Thus, mining regions can already work towards improving local infrastructure, expanding access to services, and creating family-friendly environments to better support current residents and attract a more diverse and highly skilled workforce.

4 Policy efforts to tackle mining workforce issues

The resurgence of mining, driven by the rising demand for critical minerals, is reshaping global policy priorities. Many governments have launched dedicated strategies to secure access to key resources while safeguarding the long-term competitiveness of their mining industries, such as in Australia, Canada, the European Union, and the United States. Countries are also forming strategic alliances to promote sustainable mineral extraction and secure supply chains, such as the Sustainable Critical Minerals Alliance launched at COP15, which includes Sweden, Canada, Australia, France, Germany, Japan, the United Kingdom, and the United States (IEA, 2023[63]). Unlike past mining booms, today's policy responses emphasise not only extraction but also domestic security, responsible sourcing, environmental standards, and workforce resilience.

While national policies provide overarching frameworks, regional-level policies are needed to align workforce development, sustainability goals, and economic growth with local industry needs. Many of the national policies cited above focus on securing supply chains and investment. Regional strategies frequently integrate mining into broader regional economic development and workforce planning efforts. These efforts address not only skills shortages but also infrastructure, economic diversification, and community engagement.

Many regional strategies aim to strengthen education and training systems, recognising that an industry reliant on automation, data analytics, and environmental management requires a pipeline of highly skilled workers. They focus on collaboration between governments, industry, and educational institutions to promote a sustainable talent pipeline while addressing regional economic and social priorities. For instance, Andalusia's Strategy for Sustainable Mining 2030 (Spain) places a strong emphasis on expanding professional qualifications to support the sector's modernisation and attract young talent (OECD, 2021[53]). In Canada, the Regional Future Workforce – Critical Minerals Pilot Program is designed to attract, train, and retain talent in the critical minerals sector by fostering innovation and strengthening regional capacity (Ontario Vehicle Innovation Network, 2023[64]). And the Alaska Mining Workforce Development Plan in the United States sets out targeted actions to address skill shortages by aligning training programmes with industry needs and leveraging partnerships with local colleges and technical institutes (Alaska Miners Association, 2014[65]).

Regional initiatives often integrate mining into broader economic development strategies. These strategies aim to make mining a long-term driver of sustainable regional development rather than just an extractive industry. For example, Portugal's Strategic Vision for Alentejo 2030 emphasises mining as a driver of sustainability and infrastructure development while also promoting community engagement (Alentejo 2030, 2024[66]). Many European regions have also incorporated mining into their Smart Specialisation Strategy, such as in Lapland, Kainuu, and North Karelia regions in Finland (IEA, 2023[67]; OECD, 2025[55]). Thus, in these regions, mining contributes to broader innovation-driven economic plans, particularly through skills development in sustainable resource management and advanced mining technologies.

In addition to regional policies that take a holistic approach to mining workforce development, targeted efforts can address specific aspects driving labour shortages in the mining sector. While these broader strategies provide a foundation, addressing mining's workforce challenges requires targeted interventions. The following sections focus on four key policy areas that are important to securing a skilled and diverse workforce: expanding the talent pool, bridging the skills gap, improving the attractiveness of mining careers, and enhancing regional appeal.

Expanding the local talent pool to tackle demographic challenges

Increasing representation from under-represented groups is important to renew the talent pool amid labour shortages and an ageing population. By doing so, mining companies can address talent gaps, foster innovation, enrich workplace culture, and better align with community values. This section explores strategies to diversify the mining workforce, such as increasing the participation of women, youth, and Indigenous Peoples through targeted recruitment, tailored training programs, and promoting an open and respectful workplace culture. These initiatives aim to provide opportunities for success in the mining industry, regardless of background.

Recruitment strategies targeted at under-represented groups

Targeted recruitment efforts attempt to counter structural barriers within the industry by proactively showcasing opportunities available within the mining sector to under-represented groups. Outreach programmes play an important role by providing information to encourage women and youth to pursue careers in mining. For example, Australia's Queensland Minerals and Energy Academy (QMEA) actively promotes the resources sector to school students, with a focus on female and Indigenous participation. QMEA engages with 80 schools across Queensland under the Gateway to Industry Schools Program, hosting career events and workshops that provide exposure to the mining industry. Similarly, also in Australia, the Get Into Resources programme, sponsored by mining companies such as BHP and Rio Tinto, runs career events that connect secondary and tertiary students with industry representatives and training course providers, showcasing career opportunities in the resources sector and directly targeting women (International Institute for Sustainable Development, 2022[39]).

Some targeted initiatives are led by educational institutions. This is the case for Bergsskolan in the Värmland region (Sweden), a technical school that collaborates with local companies to encourage more women to pursue careers in mining through targeted recruitment efforts and the promotion of structural changes in the industry (see Box A.1) (Bergsskolan, 2025[68]). In Portugal, the University of Évora implemented innovation projects focusing on sustainable mining technology to cater to younger generations and encourage their involvement in the sector (University of Évora, 2020[69]; OECD, 2025[55]).

Targeted training programmes and opportunities

To complement recruitment efforts, targeted training programmes offer under-represented groups tailored opportunities to enter and advance within the mining sector. These programmes range from scholarships and educational initiatives that create pathways into the industry, targeted apprenticeship programmes, and workplace learning that help employees build the skills necessary to succeed.

Initiatives that offer targeted support or educational programmes are a key method for encouraging under-represented groups to enter the mining sector. Mining Essentials, a work-readiness programme for Indigenous individuals in Canada, is an example of a targeted training

programme. Combining classroom instruction with hands-on experience, this programme focuses on safety certifications, cultural awareness, and technical skills, improving their chances of gaining employment in the mining sector. More than 600 Indigenous individuals have graduated from the programme, with an 83% success rate in finding employment or continuing their education after completion (see Box A.2) (Mining Industry Human Resources Council, 2023[70]).

Other programmes provide support to local educational institutions or directly to potential students. For instance, BHP and the International Youth Foundation (IYF) partnered to launch the Learning Exploration Aspiration Preparation Success (LEAPS) programme, which works with schools and local non-profits to provide educational support to youth aged 11-24 in Texas and Louisiana (McCormick et al., 2018[71]). The initiative connects young people with career exposure, internships, and local job opportunities and includes the creation and expansion of school programming to better align with industry needs. Additionally, BHP sponsors the Girls in Resources Scholarships in Australia, aiming to support young women who wish to pursue engineering careers to transition to university. Administered by the Queensland Minerals and Energy Academy (QMEA), this regional scholarship initiative also includes the Girls Mentoring Program, which pairs high school girls with female industry mentors (International Institute for Sustainable Development, 2022[39]). This initiative not only provides financial support but also encourages young women to explore mining careers by offering mentorship and guidance.

To facilitate the transition from education to the workforce, targeted apprenticeship programmes create a space for under-represented groups to gain practical, hands-on experience and credentials. Some of the programmes are in partnership between mining companies and educational institutions, such as the Queensland Future Skills Partnership in Australia. The collaboration focuses on developing new qualifications in automation-related fields within open-cut mining operations. The initiative places a particular emphasis on women and Indigenous participation, with Rio Tinto reporting that 30% of the apprentices hired in 2020 were female, and more than half were Indigenous (International Institute for Sustainable Development, 2022[39]). Similarly, the Capturing Better Futures programme helps connect high school students with accredited apprenticeships in the carbon capture sector (OECD, 2024[72]). The Deadly Sista Girlz Program in Australia targets young Aboriginal and Torres Strait Islander women, empowering them to enter the workforce through skills development, mentorship, and leadership training. Supported by the Indigenous Advancement Strategy, the programme addresses the unique challenges faced by Indigenous youth, such as caregiving responsibilities, while also helping them enter careers in the mining sector (International Institute for Sustainable Development, 2022[39]).

Through in-house initiatives, companies directly address skills gaps while offering young professionals the opportunity to gain practical, hands-on experience within the industry. For example, Metlen Energy & Metals' Engineers in Action programme in Greece is a paid employment programme that targets recent engineering graduates with less than two years of experience. This initiative, which has recently expanded to Italy and the UK, provides participants with job experience, training, and mentorship in various departments of the company, helping participants build technical expertise and professional networks (see Box A.3) (Metlen Group, 2025[73]; OECD, 2025[55]). Similarly, in Chile, Codelco's Graduados programme provides leadership training to university graduates, with a specific focus on attracting women into the mining sector. Approximately 40% of participants in this programme are women, helping to build a leadership pipeline (Fernandez-Stark, Couto and Bamber, 2019[35]). These targeted programmes facilitate the entry of under-represented groups into the industry by equipping them with specific skills and experience needed in the sector.

Promoting local skills development—targeted programmes and deeper collaboration

The mining sector requires educational alignment and broad training opportunities to keep pace with technological and sustainability advancements. As a result, many regions are focusing on local initiatives to foster innovation and ensure a steady supply of skilled workers. Current best practices aim to align educational systems with evolving demands and improve accessibility to reduce barriers to entry. This involves specialised courses, hands-on training models, and data-driven curriculum updates. Increasing flexibility in training systems, such as offering micro-credentials and competency-based assessments, helps create adaptable educational pathways. This section surveys policy approaches that seek to address skill gaps and concludes with a summary of common elements.

Strengthening the alignment of educational and training with industry demand

Targeted programmes developed in close collaboration with mining companies and industry associations offer a direct route to equip learners with the sector's most in-demand skills. These specialised programmes can be offered by universities, vocational institutions, or hybrid public-private ventures and typically draw on close collaboration between public authorities, education providers, and private-sector partners. By integrating real-world inputs from industry, education providers can continuously update their curricula to reflect new technologies and sustainability requirements.

A number of higher education institutions have begun creating specialised degrees that focus on the cutting edge of mining technology and sustainability. In Finland, the University of Oulu's Master's in Sustainable Mining—funded by the EU's Erasmus+ Programme—blends geoscience with training on resource-efficient practices (University of Oulu, 2025[74]). The school collaborates with Finnish mining companies to shape module content so that graduates emerge with skills in digital mining tools as well as environmental management. Similarly, the Polytechnic Institute of Leiria in Portugal offers a Management and Advanced Technologies in Mineral Resources programme (Polytechnic of Leiria, 2025[75]; OECD, 2025[55]). Supported by mining-company scholarships, the course combines engineering, management, and green innovation. This arrangement both broadens student access and promotes alignment between the curriculum and real-world sector priorities. Overall, these programmes aim to foster a new generation of mining engineers who can address sustainability imperatives as well as technical challenges.

At the vocational level, partnerships that bring together government, industry, and local training providers can swiftly respond to changing skill requirements, especially around automation. In Western Australia, for example, teachers at the technical institutes discovered that mining companies were increasingly using autonomous trucks. Recognising a real career opportunity for their students, TAFE (Technical and Further Education) institutes, mining companies (such as Rio Tinto), and policymakers collaborated to create new curricula for autonomous haulage, robotics, data analytics, and IT systems (METS Ignited and NERA Industry Growth Centres, 2019[30]). The programme takes advantage of cutting-edge facilities, which allow students to simulate real-world scenarios in a controlled environment. Meanwhile, Bergsskolan, a technical school in Filipstad (Sweden), as previously mentioned, maintains strong ties to local mines, providing students with hands-on exposure to advanced geological methods and operational best practices (see Box A.1) (OECD, 2025[55]; Bergsskolan, 2025[68]). These vocational and technical programmes are well-placed to quickly adapt course content, create hands-on learning experiences, and foster apprenticeship-style models that translate into immediate workforce impact.

Some specialised programmes rely on interdisciplinary and cross-institutional collaborations to address large-scale skill gaps in mining. In Brazil, for example, the International Youth Foundation (IYF) is working with the Secretary of Education in Pernambuco to revamp logistics curricula across multiple institutions, integrating supply-chain management, teacher training, and practical projects tailored to the mining sector's demands. In Mexico, similar partnerships update technical programmes with data science

modules that can readily support data-driven tasks in modern mining operations (International Youth Foundation, 2024[76]). In Chile, the Consejo Minero, representing mining companies, and Fundación Chile, a public-private partnership focused on innovation, have jointly developed initiatives that update skills frameworks and create training packages to match the industry's technological advancement. Complementing these efforts, the Corporación Alta Ley integrates competency frameworks into research and higher education, with the overall goal of enhancing the long-term competitiveness of Chilean mining by fostering technological innovation and strengthening human capital (see Box A.4) (Fernandez-Stark, Couto and Bamber, 2019[35]). These initiatives unite government, industry, and international organisations to tackle simultaneously skill shortages, strengthen regional innovation, and promote a more agile workforce in resource-intensive regions.

While classroom learning provides foundational knowledge, hands-on experience through apprenticeships and internships can bridge the gap between theory and practice. By giving trainees direct exposure to operating mines, new technologies, and safety practices, these programmes can dramatically accelerate skill acquisition, deepen students' understanding of workplace culture, and improve overall employability. For employers, structured work-based learning helps to alleviate skills shortages while reducing turnover, as apprentices and interns often transition into full-time roles.

Policy initiatives often blend various aspects, such as mapping future skills, offering financial support, or co-designing programmes with employers so that apprentices and interns receive the most relevant experience needed. For example, in Andalusia (Spain), reforms to the National Vocational Training Programme encourage deeper collaboration between mining companies and local training centres, yielding curricular modules directly tied to local skills needs (European Commission, 2024[77]). Kainuu and Central Ostrobothnia (Finland) launched the Process Academy pilot, where educators and industry jointly identify required competencies and create specialised work placements (European Social Fund, 2022[78]; OECD, 2025[55]). Meanwhile, in Australia, the New Energy Apprenticeship and Skills initiatives, though focused on clean energy, combine stipends, structured mentoring, and industry-driven content to rapidly upskill newcomers (see Box A.5) (Australian Department of Industry, Science and Resources, 2023[10]). In these examples, strong employer engagement, well-integrated vocational pathways, and ongoing learner support help to accelerate practical skill development and heighten workforce readiness.

The rapid changes in the mining sector mean that anticipating future skill requirements and aligning education and training systems accordingly and proactively can prevent bottlenecks. By mapping emerging competencies, policymakers, educational institutions, and industry actors can collaborate on timely curriculum updates, career guidance, and supportive measures that keep the labour market in sync with actual demand.

Several initiatives illustrate how local partnerships leverage data to inform education and training. In Central Ostrobothnia (Finland), the KOE project connects Kaustinen's local authority with the Kokkola University Consortium Chydenius to map forthcoming skill needs in forestry, renewable energy, and mining so that educational offerings evolve alongside industry demands (see Box A.6) (Kokkola University Consortium Chydenius, 2025[79]; OECD, 2025[55]). Each of these policy examples can be adapted to serve the mining sector.

Other programmes use broader institutional frameworks to predict and address skill shortages. Jobs and Skills Australia (JSA), for instance, compiles a national supply-and-demand model, incorporating vocational education, higher education, apprenticeships, and migration trends to project emerging gaps across the entire economy, including mining (Australian Department of Industry, Science and Resources, 2023[10]). Sector-focused councils further refine these projections by uniting industry leaders, government agencies and training institutions to define skill requirements, develop occupational standards, and shape curricula. This consultative structure underlies the International Youth Foundation's (IYF) approach in Mexico, where public job data and investment analytics inform collaborative efforts with technical vocational education training (TVET) systems to introduce market-relevant modules, from technical competencies to soft skills (Ortega, 2017[80]).

Improving accessibility of education and career pathways

Even when high-quality programmes exist, their location, format, or entry requirements can exclude potential talent. This can be especially the case for local populations in remote mining regions or among under-represented groups such as women and Indigenous communities. Diversifying the types of courses offered and adopting flexible, skills-focused frameworks can help learners acquire industry-relevant competencies at different stages of their education or employment.

Decentralising vocational education allows regions to create programmes tailored to their community, enabling workers in remote mining areas to acquire relevant skills without relocating. In Finland and Sweden, vocational education is managed locally, allowing for the institutions to specialise in the most locally relevant field (OECD, 2025[55]). This allows regions with a strong mining sector to offer courses in mining, mechanical engineering and other resource-oriented programmes. By establishing or expanding campus offerings in areas where resource extraction plays a key economic role, these initiatives encourage local youth to consider mining careers and support incumbent workers who need further qualifications. This decentralised model reduces travel costs, fosters tighter links between educational institutions and nearby employers, and helps mining communities develop stronger homegrown talent pools.

Multiple learning pathways, such as apprenticeships, micro-credentials, or bridging programmes, can accommodate a wider range of learners, including mid-career workers seeking to upskill. At the national level, Australia's push for fee-free vocational training in critical minerals aims to reduce cost barriers for prospective mining professionals (Australian Department of Industry, Science and Resources, 2023[10]). Coupled with specialised apprenticeships in energy transition technologies, the strategy encourages movement from vocational to advanced education programmes. These efforts can also be led by mining companies themselves. Roy Hill, a major player in the Pilbara region (Australia), introduced autonomous technologies alongside a workforce transition strategy (METS Ignited and NERA Industry Growth Centres, 2019[30]). Beyond in-house training in data analytics and tele-remote operations, the company offers two additional days of career development per year and is exploring transition services for displaced workers. By embracing short, targeted training modules and continuous career support, Roy Hill supports employees as they adapt to emerging roles, minimising the disruptive effects of automation while expanding the skill set of the existing workforce.

Short professional courses and micro-credentials address a pressing need for quick, targeted training, particularly among existing employees who cannot commit to lengthy degrees. The Polytechnic Institute of Leiria (Portugal) and the University of Oulu (Finland) both offer condensed professional courses—often tailored for employed adults—to upskill workers without the time or resources to pursue full degrees (Polytechnic of Leiria, 2025[75]; University of Oulu, 2025[74]; OECD, 2025[55]). These micro-credentials have seen a strong uptake among mid-level employees seeking rapid, industry-relevant qualifications. In Australia, BHP Mitsui Coal's New to Industry programme provides a 12-month traineeship with on-the-job learning for Indigenous Australians, which awards a micro-credential. This short, targeted format has proven especially effective in boosting the representation of women and Indigenous Peoples, as 75% of past participants were female (International Institute for Sustainable Development, 2022[39]).

Initiatives based on skills-based assessments also increase accessibility by adapting to workers' particular skill levels. These approaches base achievement on competency-based frameworks rather than a set programme or number of years attended. This is the approach of a new apprenticeship model in Australia aimed at heavy-duty diesel mobile plant mechanics. Through a series of task-based "proof point" assessments, trainees can demonstrate proficiency step-by-step rather than adhering to a fixed timeline (see Box A.7) (Mining and Automotive Skills Alliance, 2025[81]). Such flexibility helps employees gain recognised credentials without lengthy retraining while still receiving structured support and practice for more challenging competencies. In another example, Kainuu Vocational College (Finland) uses flexible programmes that assess learners' competencies in real work environments, enabling them to progress at their own pace (Kainuu, 2025[82]; OECD, 2025[55]).

Improving the appeal of mining careers

Many prospective workers see mining as "dirty" work, which deters them from entering the industry. As mining companies modernise their operations and vie for skilled talent, they must contend with these negative preconceptions about the industry, especially related to safety, employment conditions and environmental impact. This section explores how stakeholders—ranging from government agencies and civil society groups to mining firms themselves—are enhancing working conditions, compensation packages, and broader communication efforts to present mining as a viable, attractive, and increasingly sustainable career choice.

Enhancing employment conditions and communication about mining jobs

Addressing job-level concerns related to job and workplace conditions to align with workers' preferences for safety and work-life balance can help to recruit and retain a productive workforce. Lack of career development, inadequate compensation, workplace inflexibility and meaningless work are the top reasons cited by mining employees for why they are likely to leave their jobs. The last is particularly important among young workers who increasingly express a desire for purpose at work (McKinsey and Company, 2023[9]). Efforts such as the MARS programme in Central Australia, an inter-agency collaboration, underscore the importance of proactively addressing psychosocial hazards and fostering supportive, welcoming work environments (see Box A.8) (Mining and Automotive Skills Alliance, 2024[31]). The programme focuses on creating mentally healthy workplaces, building a culture of safety and inclusivity, and preparing the future workforce to manage emerging psychosocial hazards. These include risks such as isolation from remote work, job insecurity, and digital monitoring, amplified by technological change, evolving work patterns, and rising mental health awareness. By embedding comprehensive well-being practices alongside traditional safety measures, the programme aims to boost retention and meet the growing demand among employees for meaningful and balanced work.

At the same time, clear and proactive communication about the nature and benefits of modern mining jobs can help alleviate concerns and demonstrate the sector's potential for stable and rewarding careers to potential workers. Initiatives use multi-channel communication strategies to showcase mining as a modern, high-tech industry with robust safety standards, competitive wages, and clear career progression. For instance, in Australia, structured frameworks like the Attraction and Retention Project Hub outline clear career pathways and offer tailored guidance to prospective employees. Developed through a collaboration among industry associations, government agencies, and workforce development experts in key mining regions, the Hub serves as a central resource designed to provide up-to-date information, interactive training sessions, and direct links to career advancement opportunities (Mining and Automative Skills Alliance, 2025[83]). Similarly, companies such as Oyu Tolgoi in Mongolia leverage social media platforms to provide real-time insights into their operations, highlight advanced safety measures, and share success stories about career development opportunities—efforts that help address concerns about mining (Skoldeberg et al., 2023[84]). Collectively, these communication efforts not only dispel myths about mining but also inspire confidence in the sector's commitment to a stable and rewarding future.

Boosting sectoral image and public perception

Even when working conditions improve, the mining sector still grapples with broader reputational challenges ranging from environmental impact to strained community relations. Building trust in the community, demonstrating transparency in operations, and openly engaging with stakeholders are important steps towards reshaping public opinion. By positioning mining as a partner in community development and showcasing its capacity to operate sustainably, companies and governments can foster more constructive relationships that extend well beyond individual worksites.

A set of initiatives focuses on education and outreach to demystify modern mining. For example, Fundación Minería y Vida in Andalusia (Spain), founded in 2012 by a consortium of mining companies and regional stakeholders, employs educational campaigns, community outreach, workshops, and training programmes to highlight the economic, social, and environmental benefits of sustainable mining practices (see Box A.9) (Fundación Minería y Vida, 2024[85]). Similarly, in Greece, the Hellenic Survey of Geology and Mineral Exploration established a museum in Athens that educates visitors on the historical and contemporary significance of minerals, helping to foster a more informed and balanced public perspective on mining (National Geological Museum of Greece, 2025[86]; OECD, 2025[55]). These programmes, often managed through foundations, focus on providing the public with clear, accessible information about mining's contributions to economic growth, technological innovation, and sustainable development.

Some efforts emphasise direct community engagement and trust building through transparency and collaboration. Rio Tinto (a major mining company in Australia) has a partnership with the Yinhawangka Aboriginal Corporation (YAC) for the Western Range mining that illustrates this approach. In this case, co-designing the mine and developing a joint social and cultural heritage management plan has enabled local communities to actively participate in environmental decision-making (Mining and Automotive Skills Alliance, 2024[31]). At the Eagle Mine in Michigan (United States), the introduction of a Community Scorecard allows residents to anonymously evaluate the company's performance in areas such as environmental stewardship, safety, and transparency so that company practices evolve in response to stakeholder concerns (see Box A.10). Similarly, after an independent study found widespread distrust among the local community, Minera Yanacocha in Cajamarca (Peru) implemented a range of trust-building measures, such as relocating their headquarters closer to the community, sponsoring a local radio station, encouraging staff to participate in community life, and establishing an external advisory board to monitor the situation (Skoldeberg et al., 2023[84]).

Digital outreach and on-site community participation are also important strategies for transforming perceptions. Oyu Tolgoi in Mongolia, previously mentioned, has embraced social media as a cornerstone of its communication strategies to communicate transparently about its operations. The company actively participates on platforms such as Facebook, Twitter, and YouTube, engaging with almost 20% of Mongolia's Facebook population in 2013. Their strategy includes tracking metrics like retweets, page visits, and on-site information centre engagements, which helps refine their messaging and maintain transparency. Similarly, the Sustainable Mining Bootcamp organised by PT Newmont Nusa Tenggara in Indonesia offers a hands-on, immersive experience for participants from diverse backgrounds (Skoldeberg et al., 2023[84]). By allowing them to witness firsthand how modern mining operations integrate environmental care, social responsibility, and economic efficiency, the bootcamp helps to reshape perceptions and build broader public support for sustainable mining practices.

Fostering a welcoming workplace culture

Beyond recruitment and training, a welcoming workplace culture can help to increase the representation and retention of under-represented groups in mining. Many companies are actively implementing policy initiatives that promote gender equality, support Indigenous employees, and create a more welcoming environment for under-represented groups. These efforts both directly support under-represented employees and create mentorship and career development opportunities to promote long-term integration. While many of these policies are run by companies or institutions, regional governments can leverage their relationships with local stakeholders to push for similar measures.

In some cases, companies are developing policies to actively support under-represented employees, particularly women and Indigenous people, by creating an environment where they can thrive. For instance, Codelco in Chile has introduced policies to facilitate the integration of women into the mining workforce, such as reducing experience requirements and introducing more flexible work options for women. As a result, female representation at the mine increased to 23% by 2018, a significant improvement that aligns

with Codelco's broader commitment to gender equity. Furthermore, state-of-the-art technologies such as automated fleets have contributed to creating a more welcoming work environment by reducing physically demanding tasks and offering more accessible roles. Similarly, Fortescue Metals Group (FMG) in Australia introduced several family-friendly policies, including flexible working arrangements and paid parental leave, and has been recognised for the 25% increase in women's participation in senior leadership roles by 2021. FMG's Billion Opportunities Program supports Indigenous women entrepreneurs and promotes their involvement in the mining sector, with a focus on empowering local women and providing opportunities for leadership development and business ownership (International Institute for Sustainable Development, 2022[39]).

Mentorship and career development programmes help under-represented employees navigate their careers and advance within the mining sector. Initiatives such as the Women in Mining USA Mentor Network and the International Women in Mining (IWiM) Mentoring Program, a cross-company initiative, offer structured mentorship opportunities for women, connecting them with experienced professionals in the mining sector (International Women in Mining, 2024[87]; Women in Mining USA, 2025[88]). These programmes aim to increase the representation of women in mining by providing tailored career advice, networking opportunities, and guidance on overcoming industry-specific challenges. Similarly, the Society for Mining, Metallurgy & Exploration (SME) Mentoring Program provides young professionals and students with access to seasoned experts who help them develop the technical and soft skills necessary for career growth in mining (Society for Mining, Metallurgy & Exploration, 2025[89]). SAP, a multinational technology company, has piloted inter-generational mentoring, where younger employees are mentored by more seasoned colleagues (McCormick et al., 2018[71]). This exchange fosters innovation and builds mutual respect between generations, helping employees of all ages contribute to the company's success while advancing their careers.

Building more attractive mining regions for workforce attraction and retention

Workers are placing greater importance on the quality of life in their communities, which can be a particular challenge in remote areas where mining activities often occur. Local infrastructure, affordable housing, and internet speeds are identified as features of places where families are more likely to settle and thrive (OECD, 2023[90]). To face this challenge, mining regions are adopting a multi-faceted approach by offering support and relocation services for workers and their families, investing in infrastructure and amenities, and fostering local economic development to create a supportive environment and sustain long-term mining operations. This is in parallel with mining companies, which are also now placing greater emphasis on ESG programmes, in addition to job creation, to better share the benefits of mining with local communities (OECD, forthcoming[34]).

Providing support and relocation services for workers and their families

To facilitate the recruitment and settlement of non-local mining workers, several regions offer targeted relocation services. These initiatives focus on easing the transition into remote areas by providing housing, integration support, and community engagement. For instance, the municipality of Sotkamo in Finland provided housing for newly arrived mining workers, enabling a smooth transition as mining operations scaled up (OECD Field Visit, 2024[91]). Similarly, International House Joensuu in North Karelia (Finland) offers comprehensive support to foreign residents, assisting workers and their families with integration into local communities (see Box A.11) (International House Joensuu, 2025[92]). In Sweden, programmes such as Samarkand2015 in Ludvika and SmartMove by Business Region Örebro provide tailored relocation services that address both practical moving costs and community integration (Samarkand2015, 2025[93]; Smart Move Örebro, 2025[94]). In Lapland, the Sodankylä municipality's mining programme actively supports new inhabitants while communicating environmental impacts to build trust with residents (Sodankylä, 2017[95]; OECD, 2025[55]).

Investing in infrastructure and amenities

Investments in local infrastructure and amenities can improve living conditions and regional attractiveness. These initiatives focus on enhancing housing, healthcare, education, and transportation networks to create vibrant communities around mining operations. For example, in Skellefteå, Sweden, development programmes addressing housing, infrastructure, and new educational initiatives were launched to support the planned Northvolt Ett battery cell gigafactory (OECD, 2023[96]). Similarly, in Central Ostrobothnia, Finland, the Kokkola Works Campaign brings together the city, local companies, and stakeholders to enhance local services and strengthen the workforce across multiple industries (Kokkola, 2025[97]; OECD, 2025[55]). In South Australia, BHP's expansion of its Olympic Dam operation includes the development of a state-of-the-art desalination plant and a 600km pipeline network as part of the Northern Water project, which will not only support mining operations but also improve regional water security and overall living conditions (Government of South Australia, 2025[98]).

Supporting local economic development

Building up local economies helps retain workers by fostering community resilience, creating diverse opportunities, and enhancing the overall quality of life in mining regions. Efforts in this area focus on promoting economic resilience through local procurement, collaboration with small and medium enterprises (SMEs), and the creation of industry clusters. In the face of fluctuating resource prices and eventual mine closures, it is important to build economic resilience in mining regions. For instance, Zinkgruvan Mining's ReThink initiative in Örebro region (Sweden) helps support local businesses outside of mining through workshops, mentorship, and networking (see Box A.12) (Zinkgruvan Mining, 2025[99]; OECD, 2025[55]). This initiative not only promotes economic diversification but also mitigates the potential economic shocks caused by the closure of mining operations. Similarly, in remote Indigenous communities, often located near mining activities in Australia, a non-profit, Enterprise Learning Projects, supports micro-businesses, including traditional artwork and tourism, creating employment and mentorship opportunities for populations that are historically excluded from resource-related economic opportunities (McCormick et al., 2018[71]).

Supporting small and medium-sized enterprises (SMEs) and fostering innovation clusters also helps support regional economic development, particularly in mining areas. The "Sun Corridor" in Arizona has become a key hub for mining automation technologies, bringing together global players like Caterpillar and Komatsu alongside over 750 local technology suppliers. Arizona has cultivated this cluster through the Arizona Technology Council, which facilitates collaboration and provides a space for businesses to network and innovate. This clustering model also highlights the role of local businesses in leveraging global supply chains and technology transfer (see Box A.13). In Norway, a similar approach has been applied, where strong government support and tax incentives have fostered the growth of oil and gas technology clusters. Norway's focus on technology collaboration has enabled local firms to supply global markets, contributing significantly to its economy (METS Ignited and NERA Industry Growth Centres, 2019[30]). This networked approach, where businesses, government, and academic institutions work in tandem, has allowed Norway to stay competitive in the international market while diversifying its regional economies beyond resource extraction.

The development of technology clusters not only strengthens local economies but also helps regions adjust to changes in the mining sector. For example, Pittsburgh has transformed from a traditional resource-rich region into a hub for automation and robotics, leveraging its strong educational institutions, such as Carnegie Mellon University. This transition has allowed Pittsburgh to diversify its economy and attract multinational companies like Uber and Caterpillar, which now collaborate with local firms to advance automation technologies. The city's transformation has been driven by close partnerships between the tech sector, universities, and local government, creating a thriving entrepreneurial ecosystem. The region's ability to innovate and produce skilled workers in automation has resulted in significant job growth, with Pittsburgh's computing workforce expanding by nearly 50% between 2009 and 2015 (METS Ignited and NERA Industry Growth Centres, 2019[30]). This success serves as a model for other mining regions, showcasing the value of building diversified economic clusters that extend beyond traditional resource extraction.

5 Conclusion

The mining workforce faces evolving challenges as it adapts to the changing needs of the sector driven by soaring global demand for critical minerals and technological change. After considering the key trends of the mining workforce and the priority issues of the mining labour market, the paper surveyed a range of policy initiatives designed to broaden the talent pool, bridge skills gaps, enhance job appeal, and boost regional appeal.

Across policy initiatives, close public-private collaboration, flexibility, data-driven solutions, and a push for holistic approaches emerge as common themes. For one, close collaboration between mining companies, educational institutions, and government bodies helps to keep programmes relevant and reduce financial barriers by pooling available resources, so that curricula and training programmes keep up with technological and environmental shifts. Flexible models—ranging from specialised degrees and hands-on apprenticeships to micro-credentials and competency-based assessments—enable rapid upskilling and adaptation to technological and market changes. The use of data-driven methods, through surveys, forecasting tools, etc., helps to anticipate challenges and customise interventions accordingly. Finally, integrating technical training initiatives with soft skills, mentorship, and community engagement helps increase the appeal of the sector and region to under-represented groups.

While these strategies offer a robust foundation, the relative importance of each factor and the most effective actions will depend on local specificities. In some regions, addressing infrastructure deficits may take precedence. In others, strengthening industry–education partnerships or bringing in under-represented workers could be paramount. This calls for tailored interventions that address the unique challenges and opportunities of each mining community.

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Note

[1] For more information on the Mining Regions and Cities Initiative, see https://www.oecd.org/en/topics/mining-regions-and-cities.html.

Annex A. Detailed policy examples

Box A.1. Bergsskolan in Värmland, Sweden: A hub for mining education and collaboration

Bergsskolan, a specialised technical school in Filipstad within Sweden's Värmland region, trains the next generation of mining professionals. The school currently enrols about 90 students each year—approximately half of whom follow its dedicated mining track. Its student cohort is predominantly older and male: 60% are over 25 years old, while 80% of its attendees are male.

The institution's three-year curriculum emphasises hands-on, practical learning, offering extensive opportunities for real-world experience through internships with local mining companies. Nearly a quarter of its students are engaged in internships.

Moreover, Bergsskolan maintains strong partnerships with mining firms to deliver upskilling programmes that respond directly to evolving industry needs, a collaboration that is reflected in its high graduate job placement rate. Beyond technical training, the school is committed to increasing the share of women in the mining sector by partnering with local enterprises to address gender imbalances and promote structural changes that encourage more women to consider careers in mining.

Source: (OECD, 2025[55])

Box A.2. Mining Essentials: Empowering indigenous participation in Canada's mining sector

Established in 2010 through a partnership between the Mining Industry Human Resources Council (MiHR) and the Assembly of First Nations (AFN), the Mining Essentials programme is a pre-employment training initiative designed to equip Indigenous individuals with the skills necessary for successful careers in the mining industry. This programme addresses the unique challenges faced by Indigenous communities by integrating culturally relevant teachings with industry-validated competencies.

The Mining Essentials curriculum spans 285 to 360 hours, combining classroom instruction with practical enrichment activities. Participants engage in face-to-face or virtual training sessions focusing on essential and work-readiness skills deemed important by the mining sector. These sessions are complemented by site visits, hands-on projects, guest lectures, and additional certifications, such as safety training and mine tours, tailored to the specific needs of the training site and its industry partners.

A distinctive feature of the programme is its emphasis on cultural relevance. The curriculum incorporates traditional Indigenous teaching methods and media, enabling participants to relate the material to their cultural contexts. This strategy fosters a deeper understanding and retention of the skills taught, bridging the gap between traditional knowledge and modern industry practices.

Between 2010 and 2023, over 600 Indigenous individuals graduated from the programme, with 83% securing employment in the mining sector or pursuing further education upon completion. This high success rate underscores the programme's effectiveness in enhancing employability and supporting economic development within Indigenous communities. Funding and support for the programme are derived from collaborations between industry stakeholders, educational institutions, and Indigenous organisations.

Source: (Mining Industry Human Resources Council, 2023[70])

Box A.3. Metlen Energy & Metals' Engineers in Action in Greece: Supporting the next generation of mining engineers

In 2014, METLEN Energy & Metals in Greece introduced Engineers in Action, an initiative designed to bridge the gap between academic learning and industrial practice for new engineering graduates. This 12-month, paid placement programme immerses recent graduates in real-world projects, allowing them to acquire technical and professional skills while actively contributing to the company's operations. In its latest cycle, the programme has broadened its scope to welcome graduates from Italy and the United Kingdom, in addition to those from Greece.

The initiative selects promising engineers—typically those with less than two years of experience—and places them across various departments, where they receive guidance from experienced mentors. Participants gain exposure to state-of-the-art technologies, sustainable practices, and collaborative, multidisciplinary teamwork, all of which enhance their employability and technical proficiency.

During the inaugural cycle (2015-2016), eleven young engineers underwent 100 hours of targeted training combined with job rotations across key company functions. With an investment of over EUR 200 000 in salaries, accommodation, and training resources, the programme resulted in 10 out of the 11 participants securing full-time employment within three months of completion.

By providing vital hands-on experience, focused skill development, and robust networking opportunities, Engineers in Action addresses youth unemployment while renewing the industrial talent pool. This initiative shows the importance of aligning educational outcomes with industry needs to cultivate a new generation of capable professionals.

Source: (OECD, 2025[55])

Box A.4. Corporación Alta Ley: Future-proofing Chile's mining sector through innovation and skills development

The Corporación Alta Ley was launched in 2015 as a public-private initiative to transform Chile's mining industry into a more technologically advanced, globally competitive, and sustainable sector. Developed under the leadership of Chile's Ministry of Mining, with support from the Chilean Economic Development Agency (CORFO), the initiative brings together government, industry leaders, research institutions, and international partners to drive innovation, strengthen human capital, and improve long-term productivity in the mining sector.

A cornerstone of Alta Ley's work is integrating competency frameworks into research and higher education, ensuring that Chile's workforce is equipped with the skills required for Mining 4.0—a sector increasingly defined by automation, robotics, and digital operations. The initiative has helped develop specialised technical programmes in partnership with universities and vocational training centres, defining key competencies for roles in artificial intelligence, automation, and remote mining operations. One example is its collaboration with Fundación Chile and Consejo Minero (Chile's mining industry association), which mapped out the skills needed for automated mineral processing plants, leading to the creation of new university-level courses aligned with industry demand.

Beyond workforce development, Alta Ley also drives technological innovation by supporting research and development projects, particularly in low-emission mining technologies, resource efficiency, and digitalisation. The Alta Ley Technological Roadmap (2015–2035) serves as a blueprint for innovation, identifying key challenges and opportunities for Chile's mining sector over the next two decades. It has backed pilot projects on predictive maintenance for mining equipment, AI-driven geological exploration, and the use of sensors for real-time monitoring of mineral extraction processes, through its innovations projects portfolio estimated at USD 400 million in 2017. Additionally, it has contributed to strengthening Chile's World-Class Suppliers Program, which supports collaboration between mining firms and local suppliers to foster an ecosystem of mining-related technological development.

Funded through a mix of government grants, industry co-financing, and international partnerships, Alta Ley exemplifies how a strategic, multi-stakeholder approach can modernise mining while fostering economic resilience and workforce adaptability. Its work has already influenced national mining policies, industry training programmes, and investment in mining innovation, reinforcing Chile's role as a leader in sustainable mineral extraction.

Source: (Corporación Alta Ley, 2025[100]; Corporación Alta Ley, 2023[101])

Box A.5. Energising Australia's workforce: The New Energy Apprenticeships and Skills Programs

In 2022, the Australian Government introduced the New Energy Apprenticeships Program, allocating AUD 95.6 million to support the nation's transition to a clean energy economy. This initiative offers up to AUD 10 000 in financial assistance to apprentices pursuing careers in designated clean energy sectors, including renewable energy generation, battery storage systems, and electric vehicle infrastructure. The support is structured through three milestone-based payments of AUD 2 000 each, ensuring sustained assistance throughout the apprenticeship. Beyond financial aid, participants benefit from industry-based mentoring, peer networking opportunities, and tailored career guidance, facilitating integration into the evolving energy workforce.

Complementing this, the New Energy Skills Program—backed by AUD 9.6 million in funding—focuses on modernising training curricula to align with industry needs. This programme fosters collaboration among government bodies, educational institutions, industry representatives, and unions to develop new qualifications and micro-credentials. A significant aspect is the partnership with vocational education and training (VET) providers to incorporate advancements in automation, energy efficiency, and digital technologies into their programmes.

These initiatives underscore the importance of robust employer engagement so that apprentices acquire practical, hands-on experience in real-world settings. Structured mentoring and support systems are particularly beneficial for individuals transitioning from traditional sectors, such as conventional mining or manufacturing, into the burgeoning clean energy industry. By integrating financial incentives, comprehensive training pathways, and industry-driven content, these programmes aim to rapidly equip Australia's workforce with the skills necessary to thrive in a sustainable energy future.

Source: (Australian Employment Relations Department, 2025[102])

Box A.6. Mapping future skills: The KOE project in Central Ostrobothnia, Finland

In 2021, Central Ostrobothnia took a decisive step toward future-proofing its workforce by launching the Kasvun, Osaamisen ja Elinvoiman (KOE) initiative. Spearheaded by Centria University of Applied Sciences, Kokkola University Centre Chydenius, and the Central Ostrobothnia Education Federation (Kpedu), this project leverages advanced skills forecasting to transform workforce planning.

Supported by the regional "Funding for Sustainable Growth and Vitality in Regions" (AKKE) programme, KOE is dedicated to identifying upcoming skill needs and tailoring educational curricula to match evolving industry demands in areas such as digitalisation, the green transition, and the bioeconomy.

By partnering with over 100 local businesses, KOE collects insights into emerging technologies and labour market trends, so that its training programmes deliver the precise, in-demand skills for both new entrants and current workers. This proactive approach not only addresses current skill shortages but also fosters a culture of continuous learning, thereby strengthening the link between education and industry.

Ultimately, KOE's forward-thinking model allows individuals and enterprises to address rapid economic changes, offering a flexible blueprint that can be adapted to support emerging sectors, such as mining, in diverse regional contexts.

Source: (OECD, 2025[55]; Centria University, 2024[103])

Box A.7. Australia's competency-based apprenticeship model for technical occupations

To address the growing demand for skilled heavy-duty diesel mobile plant mechanics in the mining and automotive industries, Australia introduced a competency-based apprenticeship model. Developed by the Mining and Automotive Skills Alliance (AUSMASA), this approach replaces the traditional fixed-duration apprenticeship system with task-based "proof point" assessments, allowing trainees to demonstrate proficiency at key milestones before advancing. This structure pushes for apprentices to gain hands-on experience and technical expertise in real-world conditions, rather than progressing solely based on the number of hours completed.

The initiative was designed in close collaboration with industry representatives, vocational training providers, and government bodies to align training content with the evolving needs of employers. Extensive consultation with mining companies, equipment manufacturers, and technical trainers helped define core occupational competencies, ensuring that apprentices are equipped with the necessary skills to work on complex diesel machinery, including that used in autonomous and electrified mining operations. The competency framework covers areas such as diagnostics, maintenance, and repair of large-scale mobile equipment, as well as new skills in digital monitoring and automation, which are needed as the sector transitions to technology-driven operations.

Funding for the programme comes from a mix of government support and industry investment, reflecting a shared commitment to closing the skills gap in critical sectors. The Australian government's investment in vocational education reform has provided the foundation for this model, while private sector contributions have supported on-the-job training and access to state-of-the-art equipment for apprentices.

Since its implementation, the programme has delivered strong results. Employers report that graduates trained under this competency-based system exhibit higher job readiness, greater confidence, and stronger problem-solving skills compared to those from traditional apprenticeship routes. The structured, task-based assessments have also helped reduce dropout rates, as trainees can advance based on their abilities rather than being constrained by rigid timelines. The model's flexibility has also attracted a broader talent pool, including individuals looking to transition from other industries, helping to diversify the workforce in mining-related technical fields.

Source: (Mining and Automotive Skills Alliance, 2025[81])

Box A.8. Mental Awareness, Respect and Safety (MARS) Program: Enhancing workplace wellbeing in Western Australia's mining sector

In 2023, the Western Australian Government launched the Mental Awareness, Respect and Safety (MARS) Program, a comprehensive initiative aimed at improving mental health, fostering respect, and ensuring safety within the mining industry. This inter-agency collaboration involves the Department of Energy, Mines, Industry Regulation and Safety (DEMIRS), the Mental Health Commission, the Equal Opportunity Commission, and the Department of Communities, working collectively to drive systemic change in workplace culture.

The MARS Program focuses on creating mentally healthy workplaces, building a culture of safety and respect, and preparing for workplace safety and emerging risks. It does so by identifying and managing psychosocial hazards and through training the future mining workforce on work health and safety, including psychosocial hazards and controls, while fostering innovation and research in mining health and safety.

A cornerstone of the MARS Program is the Landmark Study, conducted by the Centre for Transformative Work Design at Curtin University. This extensive research project gathers baseline data on workplace practices related to mental health, respect, and safety within Western Australia's mining sector. The study's insights inform the development of targeted interventions and policies aimed at enhancing worker well-being.

The programme also emphasises sector engagement, collaborating with mining companies to develop initiatives that support affected individuals, bolster workforce training, and strengthen organisational capabilities. Through its multifaceted approach, the MARS Program serves as a model for proactive measures in addressing psychosocial hazards and fostering welcoming workplace cultures.

Source: (Government of Western Australia, 2025[104]; Centre for Transformative Work Design, 2024[105])

Box A.9. Fundación Minería y Vida in Andalusia, Spain: Educating sustainable mining practices

In 2012, a collaboration of mining companies and regional stakeholders founded Fundación Minería y Vida. The initiative works to reshape public attitudes toward mining while championing sustainable industry practices. Guided by industry experts and community leaders, the initiative emphasises both the economic and social benefits of mining and the importance of environmental stewardship.

The foundation employs a diverse strategy that includes partnering with local schools, businesses, and community groups to deliver educational campaigns, workshops, and training programmes on sustainable mining techniques. Through these outreach efforts, it educates both the general public and future professionals about modern, responsible mining practices.

Although specific quantitative results are not provided, Fundación Minería y Vida continues to play an important role in promoting regional economic and social development by enhancing community awareness and understanding of sustainable mining.

Source: (OECD, 2025[55])

Box A.10. Eagle Mine's Community Scorecard in Michigan, United States: Enhancing transparency and trust through stakeholder engagement

Eagle Mine, an underground nickel and copper operation in Michigan's Upper Peninsula, has implemented a Community Scorecard (CSC) initiative to foster transparency and strengthen relationships with local communities. Launched in 2012 and lasting until 2016, this twice-yearly process enables residents to anonymously evaluate the mine's performance across five key areas: environmental stewardship, local hiring practices, safety standards, communication and engagement efforts, and community development initiatives.

The CSC meetings are structured as public forums and advertised through various media channels to encourage broad participation. During these sessions, community members use electronic devices to rate the company's performance in each area, with results displayed in real time to promote transparency. Following the meetings, the aggregated data is published on the company's website and shared with local news outlets, reinforcing Eagle Mine's commitment to openness.

A notable aspect of the CSC process is the active involvement of Eagle Mine's management team, including the general manager and department heads. Their presence allows for direct interaction with community members, providing an opportunity to address concerns and discuss improvement plans collaboratively. This approach has led to actionable changes in company practices, aligning operations more closely with stakeholder expectations.

Complementing the CSC, Eagle Mine supports the Community Environmental Monitoring Program (CEMP), an independent initiative managed by the Superior Watershed Partnership in cooperation with local non-profits, the Keweenaw Bay Indian Community and the Community Foundation of Marquette County. Funded by the company, which provides up to USD 300 000 in annual funding, CEMP conducts environmental monitoring to verify compliance with state permits and addresses community concerns regarding environmental impacts. This independent oversight enhances the credibility of the CSC and fosters greater community trust.

Currently, Eagle Mine uses a social licence to operate (SLO) index that also gathers information via community surveys every six months.

Through these programmes, Eagle Mine took a proactive approach to community engagement. By prioritising transparency, responsiveness, and independent verification, the company has cultivated a more trusting relationship with its stakeholders, setting a benchmark for community relations in the mining industry.

Source: (World Bank Group-CommDev, 2024[106]; CEMP, 2025[107])

Box A.11. International House Joensuu: Strengthening workforce integration in North Karelia, Finland

In response to growing labour needs and the challenge of attracting and retaining international talent, International House Joensuu was established in 2022 in North Karelia (Finland). The initiative serves as a one-stop support centre for foreign residents, including mining professionals and their families, helping them integrate into local communities.

Led by the City of Joensuu, in collaboration with regional employers, educational institutions, and public agencies, the initiative provides language training, employment guidance, social services navigation, and cultural orientation. The centre also works closely with local industries, including the mining sector, to assist foreign workers in navigating administrative procedures such as work permits and residence registration.

Since its launch, International House Joensuu has supported over 1 200 foreign residents, helping to increase retention rates for international workers across multiple sectors. The initiative has been recognised as a best practice model in Finland, demonstrating how comprehensive integration support can enhance workforce stability and contribute to regional economic growth. By facilitating smoother transitions for foreign professionals and their families, International House Joensuu strengthens the long-term attractiveness of North Karelia as a place to live and work.

Source: (International House Joensuu, 2025[108]; OECD, 2025[55])

Box A.12. Zinkgruvan Mining's Entrepreneur Program in Örebro, Sweden: Fostering local resilience

In 2018, Zinkgruvan Mining introduced the Entrepreneur Program—also known as Zinkgruvan Mining ReThink—with the objective of strengthening the local economy by nurturing entrepreneurship and preparing the community for a post-mining future. This forward-thinking initiative, developed in partnership with local stakeholders, aims to counterbalance the economic risks associated with potential mine closures.

The programme offers comprehensive support by delivering mentorship and guidance to local businesses, particularly those operating outside the mining sector. Through a series of workshops,

mentoring, and networking events, the initiative equips these companies with the skills and knowledge required to achieve independent growth. During the COVID-19 pandemic, for example, the programme provided needed additional support that helped participating businesses navigate unprecedented challenges.

To date, more than 40 local businesses have benefited from this initiative, reporting notably higher success rates and enhanced resilience compared to their peers. By fostering a vibrant and diverse local economy, Zinkgruvan Mining's Entrepreneur Program stabilises the present economic landscape and lays the foundation for the community's long-term sustainability.

Source: (OECD, 2025[55])

Box A.13. Sun Corridor in Arizona, United States: A hub for mining automation and technology

The Sun Corridor in Arizona (United States) has emerged as a central hub for mining automation technologies, fostering collaboration between global industry leaders and a vast network of local technology suppliers. This strategic clustering has been important in advancing innovation and efficiency within the mining sector.

The region has fostered an ecosystem that supports technological innovation in the mining sector, with companies such as Caterpillar and Komatsu establishing key operations. Caterpillar's Tucson Proving Grounds and Tinaja Hills Demonstration & Learning Center, along with Komatsu's Arizona Proving Grounds, serve as major testing sites for autonomous mining equipment and digital mining solutions. Complementing these global players, over 750 local technology suppliers provide advanced components, software, and engineering services, reinforcing the region's role as a node in global mining supply chains.

Collaboration between industry, government, and academia has been central to the region's success. The Arizona Technology Council facilitates industry networking and knowledge exchange through events such as the annual Tech and Business Expo, promoting cross-sector innovation in automation and advanced manufacturing. Sun Corridor Inc., an economic development organisation, has played a key role in attracting investment and supporting business expansion, so that Arizona remains competitive in the global mining technology landscape. Additionally, the University of Arizona's School of Mining and Mineral Resources has developed specialised programmes in automation and machine learning for mining, strengthening the local talent pipeline.

The Sun Corridor's strategic clustering has led to substantial advancements in mining automation, reinforcing Arizona's position as a leader in mining technology. By integrating local businesses into global supply chains, facilitating research and development partnerships, and leveraging a skilled workforce, the region has become a model for mining innovation. This collaborative model underscores the importance of integrating local businesses into global supply chains, facilitating technology transfer, and fostering a culture of continuous innovation within the mining sector.

Source: (Sun Corridor Inc, 2025[109]; Arizona Technology Council, 2024[110])

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