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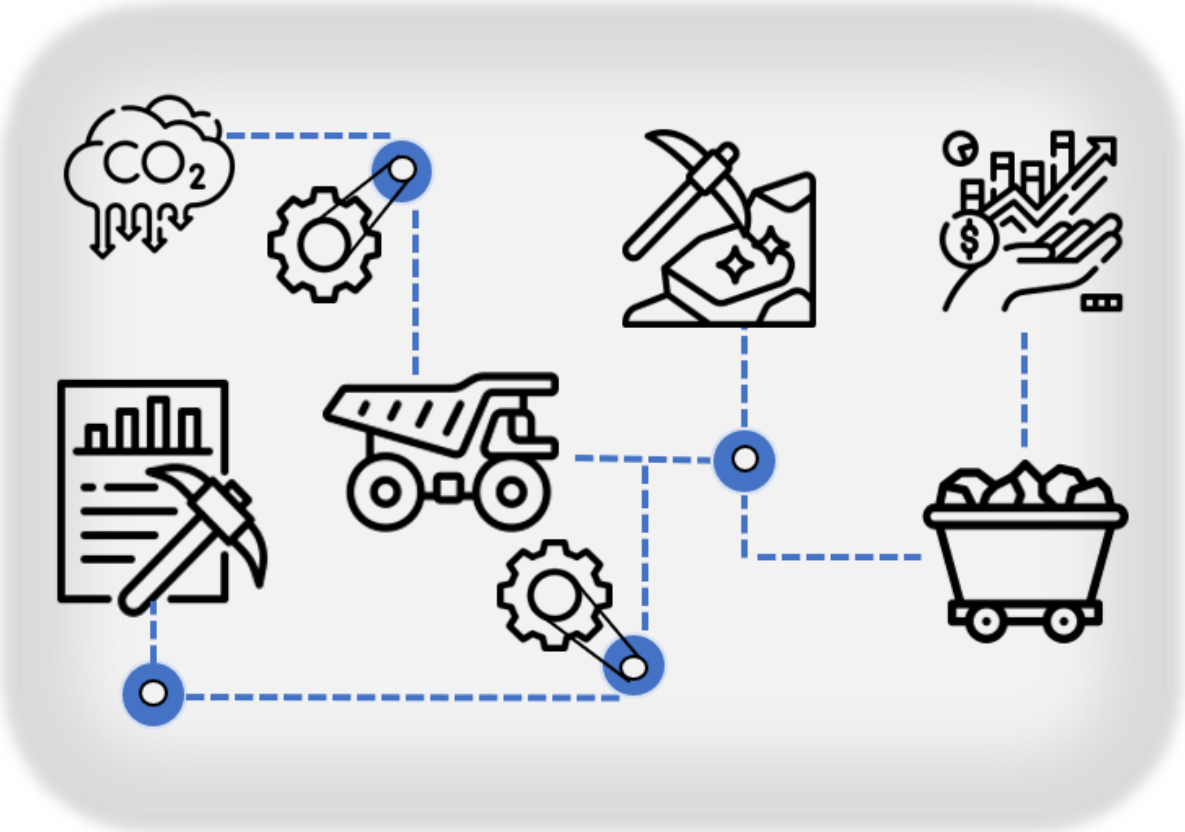
VALUE CHAINS IN MINING PERU

A growing and dynamic market (Part 2)



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Value Chains in Mining - Peru
A growing and dynamic market.

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List of abbreviations

ATDR	Technical Board of Irrigation District
BGI	Better Gold Initiative
CCD	Center for Competitiveness and Development
CCSP	Swiss Chamber of Commerce in Peru
CO2	Carbon Dioxide
CONAM	National Environmental Council
CSR	Corporate Social Responsibility
DGAAM	Environmental Affairs General Directorate
DGM	General Directorate of Mining
DIGESA	General Bureau of Environmental Health
DREM	Regional Directorate of Energy and Mines
EFTA	European Free Trade Association
EIA	Environment Effect Investigation
EITI	Extractive Industries Transparency Initiative
EPPs	Personal Protective Equipment
GDP	Gross Domestic Product
ICMM	International Council on Mining and Metals
IGAC	Corrective Environmental Management Instrument
IGAFOM	Control Instrument for the Formalization of Small Mining and Artisanal Mining Activities
IIMP	Institute of Mining Engineers of Peru
ILO	International Labor Organization
INGEMMET	Geological, Mining and Metallurgical Institute
INRENA	National Institute of Natural Resources
INRENA's IRH	Hydric Resources Intendance of the National Institute of Natural Resources
ITSE	Inspección Técnica de Seguridad en Edificaciones
LiDAR	Light Detection And Ranging
LME	London Metal Exchange
MINAG	Ministry of Agriculture
MINEM	Ministry of Energy and Mines
MRE	Ministry of Foreign Affairs
MTD	Metric Tons per Day
MTPE	Ministry of Labor and Employment Promotion
OECD	Organization for Economic Cooperation and Development
OSIGNERMIN	Supervisory Body of Private Investment in Energy and Mines
PCM	Presidency of the Cabinet
PIM	Small-Scale Mining Platform
PRODUCE	Ministry of Production
REINFO	Integral Registry of Mining Formalization
RPMV	Public Stock Exchange Registry
SBGA	Swiss Better Gold Association
SDGs	Sustainable Development Goals
SECO	Economic Cooperation and Development division is part of the Swiss State Secretariat for Economic Affairs
S-GE	Switzerland Global Enterprise
SME	Small and Medium Enterprises
SMV	Exchange Superintendency
SNMPE	National Mining, Petroleum and Energy Society
SSOMA	Occupational Health and Safety and Environment
SUNARP	National Superintendence of Public Registries
SUNAT	National Superintendence of Tax Administration

TUO	Unified Ordered Text
VAT	Value Added Tax
WTO	World Trade Organization

1. FOREWORD

The Swiss Chamber of Commerce in Peru (CCSP) has elaborated this report on Value Chains in Mining - Peru with the support of Switzerland Global Enterprise (S-GE). The Chamber thereby fosters and promotes the free-market system and encourages trade and investment within a framework of social responsibility, strong values and business ethics.

Aware of the significant needs of Peru's mining sector in terms of goods and services, this report seeks to identify business opportunities for Swiss firms addressing the following points:

- Mining: situation and outlook in Peru.
- Presence of Swiss firms in the mining value chain.
- Mines' needs to improve operations.
- Potential contributions of Swiss firms in core mining processes, smart mines, sustainable mining and traceability.
- Challenges and risks in doing business in Peru.
- Actors, responsible and sustainable value chains and institutions.

Some reports have been used to highlight key data. Various companies are to be thanked for valuable contributions for case-studies presented in the report. We are also grateful to Mrs. Andrea Baldeon and Mr. Diego Guevara for undertaking the research, elaborating some tables and writing the chapters.

Special gratitude is expressed to Dr. Philippe G. Nell for designing and writing various parts of the report as well as for the overall direction and detailed review of the report.

The Swiss Chamber of Commerce in Peru is confident that this report will increase the awareness of Swiss firms for business opportunities in Peru confirming our mission of being the main reference for trade and investment relations between Peru and Switzerland.

We wish you an instructive and pleasant read of the report on Mining in Peru.

Lima, May 2022

Corinne Schirmer
General Manager
Swiss Chamber of Commerce in Peru

2. EXECUTIVE SUMMARY

The Peruvian mining value chain has a great growth potential for suppliers providing goods and services for exploration, mining operations and maintenance. It includes products dealing with new data technologies and providing solutions to the challenges related to the environment.

The objective of this report is to identify business opportunities for Swiss SMEs in Peru focusing on four areas: i) Core Mining Processes; ii) Smart Mines; iii) Sustainable Mining and, iv) Traceability.

Market Overview: Peru is one of the richest mineral countries in the world. It is one of the biggest producers of base and precious metals. As a consequence, exports are significant. According to estimates, mining accounts for nearly 10% of GDP, while mineral export revenues reached US$40.6 billion in 2021, representing 64% of the country's total exports. The importance of mining also means that there is an equally large and diverse suppliers' market, since mining requires thousands of different products and services, either in the exploration or exploitation stage.

This report identifies Swiss companies that offer various products or services, mostly linked to clean technologies in the four areas mentioned above.

Regulatory Overview: Peru has legislation to promote social responsibility in business, labor, environmental and consumer areas. The General Mining Law and the Mining Tax Law cover all the activity in the sector. It is important to specify that mining companies are not exempt from import duties, but can benefit from temporary import duty reductions with different rates depending on the type of product.

Opportunities and Challenges: Mining offers significant business opportunities to Swiss firms offering clean technologies. The value chain in Peru prioritizes products responding to the needs of core processes with products or services generating efficiency, increasing productivity and modernizing central technologies. These needs have been identified and listed by type of mining activity. They point to substantial business opportunities.

Swiss firms have a significant potential in innovative cleantech products and solutions to strengthen the sustainability of mining economies. Several Swiss firms are presently active in Latin America or interested to enter the market. Their potential contributions in meeting key challenges are highlighted emphasizing on core mining processes, smart mines, sustainable mining and traceability.

It is also possible to enter the Peruvian mining supplier market for instance through the Minergy Scouting program that seeks to accelerate the technological transformation of the extractive industry, summoning the best technology providers in the world to present innovative and modern solutions to the challenges faced by mining and energy companies.

Doing Business in Peru raises important challenges and risks which have been documented by the World Bank in its latest Doing Business Report and by Ernst and Young with the top 10 business risks and opportunities for the mining and metal industries. Firms must be aware of bureaucratic barriers, political instability and also opportunities.

Important market players: Peru's mines purchase US$10 billion of equipment, goods and services to more than 7000 suppliers every year ranging from small to large firms and are always seeking new technologies.

Innovation as well as participating in collaborative projects with mining companies are very important. 4.0 technologies play a growing role in mining with remote monitoring, automation and data analytics. There is a strong international competition for machinery.

Through its regulatory power, the government plays an important role for mining business, as well as mining companies. Specific ministries and regulatory entities are in charge in each area.

Logistics and Distribution: Mining is a complex activity facing several logistics challenges. A close cooperation with the suppliers in the value chain is essential. The most critical logistics phase is the transport to the port for exports using public and private infrastructure.

Suppliers must get familiar with mountainous conditions, adapt correspondingly their products and services and work closely with transport companies. Market entry can be undertaken under various forms.

Case studies: Testimonials from important firms –Sika, Geobrugg, ABB, Linkminers and the Mining Innovation Hub in Peru- illustrate important point such as what companies in the mining sector require.

Swiss products are very well known for their quality and chosen for important works. In terms of solutions needed to improve productivity and address challenges, efficiency solutions, industry 4.0 and traditional mining processes are sought by mining companies. Local presence is considered as a key factor for doing business by customers.

Conclusion: The production and export of Peruvian minerals will continue to grow steadily over the coming years, mainly for copper based on clean technology production chains.

This implies that the supplier market will also grow, to make mining operations more efficient and to contribute to the decarbonization of the planet with new technologies.

Swiss SMEs are well positioned with a good reputation for reliable, high-performance, and high-quality products and services. Market entry will continue to require extensive efforts to overcome procedural barriers. The best strategy will undoubtedly be to open a branch in Peru.

3. MARKET OVERVIEW

Peru has a great geological potential concentrated in the Andean Mountains. This mineral wealth has led to the establishment of a mining tradition that has played an important role in the growth and economic development of the country. Switzerland, although not a mining nation, plays a very important role globally in the trading of commodities and the refining of gold. Its companies are also actively involved in the mining value chain with advanced clean technologies.

Peru needs suppliers to support and strengthen its mining value chain. In order to establish the basis for these business relationships, we show, on the Swiss side, some companies that offer various products or services, and on the Peruvian side, we specify the structure of their demand based on four categories: Core Mining Processes, Smart Mine, Sustainable Mine and Others (other inputs, goods or services). Although there may be elements corresponding to several categories, the objective is to determine the main characteristics of Peru's demand matching Swiss technologies.

3.1. Production of the mining sector in Peru

Peru has a great geological potential concentrated in the Andean Mountains. This mineral wealth has led to the establishment of a mining tradition that has played an important role in the growth and economic development of the country.

Peru is one of the richest mineral countries in the world. It is one of the world's biggest producers of base and precious metals. Currently, it is the world's second largest producer of copper (after Chile) and a major producer of gold, silver, zinc, among other minerals. Peru has 8.7% of the world's copper reserves, 3.7% of gold, 22.6% of silver, 14.4% of molybdenum, 7.6% of zinc, 7.1% of lead and 3.0% of tin, according to the most recent data published by the US Geological Survey[1].

Peru is among the world's and Latin America's leading producers of various metals (gold, silver, zinc, copper, lead, iron, tin, molybdenum, etc.).

Table 1. Mine Production and Reserves in Peru
(Metric tons unless otherwise noted)

Mineral	Production		Reserves
	2020	2021[e]	2021[e]
Copper[1]	2,150	2,200	77,000
Gold	87	90	2,000
Lead[1]	242	280	6,400
Molybdenum	32,200	32,000	2,300
Silver	2,770	3,000	120,000
Tin	20,600	30,000	150,000
Zinc[1]	1,330	1,600	19,000

Note: One metric ton (1,000 kilograms) = 32,150.7 troy ounces
[e] Estimated
[1] Thousand metric tons
Source: US Geological Survey.

[1] Available online: https://pubs.usgs.gov/periodicals/mcs2022/mcs2022.pdf

3.2. Export of mining products

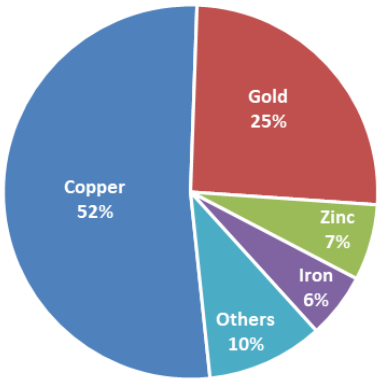
In 2021, export of metallic mining products amounted to US$39.6 billion, representing a growth of 51.6% with respect to 2020 which registered an 8.4% contraction, due to the world recession caused by Covid-19. The recovery in 2021 was very strong and benefitted from significantly higher prices.

According to estimates, mining accounts for nearly 10% of GDP, while mineral export revenues reached US$40.6 billion in 2021, representing 64% of the country's total exports. Copper was the leading export metal, in terms of value, followed by gold, zinc, iron, lead, molybdenum, tin and silver. The mining sector is very important for the generation of employment for thousands of Peruvians and represents one of the main sources of fiscal revenues[2].

Except for gold (+2%), the average price of Peru's main minerals increased very significantly in 2021 with tin (89%), molybdenum (82%), copper (51%), iron (48%), zinc (33%), silver (23%) and lead (21%).

SNMPE, Statistical Bulletin / December 2021

Figure 1. Value of exports by mineral product, 2019
(Percent)



Source: Central Reserve Bank of Peru (BCRP)

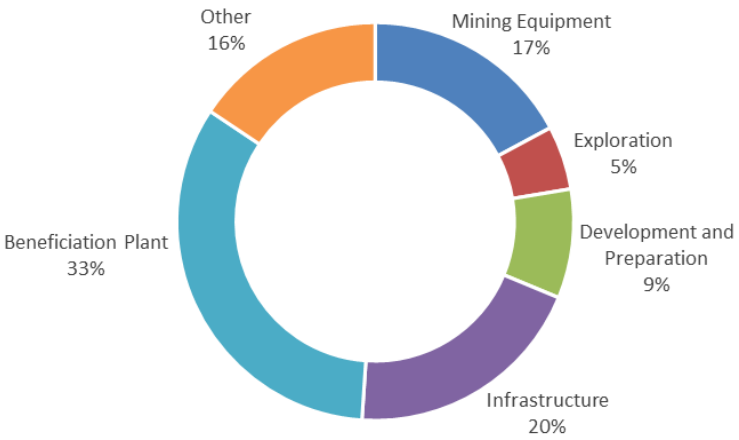
3.3. Mining investments

In 2020, investments amounted to US$4.3 billion, a 26.8% decline compared to 2019. Investment in Development and Preparation amounted to US$384 million (-65.7%), to US$744 million in Mining Equipment (-28.6%), to US$224 million in Exploration (-37.1%), to US$858 million in Infrastructure (-35.9%). On the other hand, Beneficiation Plant totaled US$1.4 billion, reflecting an increase of 7.7%[3].

Investments registered in Beneficiation Plants[4] accounted for the largest share of mining investments in 2020 with a 33.3% share of the total. Infrastructure was the second largest investment item (20% of total) and Mining Equipment ranked third (17% of the total).

[2] Available online: www.ey.com/es_pe/mining-metals/mining-metals-investment-guide
[3] Available online: www.minem.gob.pe/_publicacion.php?idSector=1&idPublicacion=634
[4] Beneficiation Plant refers to the section of a mine operating the first separation of the rocks with the metals through a set of physical, chemical and/or physical-chemical processes.

Figure 2. Structure of annual mining investment by item, 2020
(Percent)



Source: Ministry of Energy and Mines (MINEM)

Investment in equipment is mainly concentrated in mining operations equipment (drilling rigs, dump trucks, etc.), safety equipment (monitoring equipment for ventilation systems, dust, gases, etc.), railroad equipment (locomotives, cars and trains) and auxiliary equipment (tractors, trucks, tankers, among others).

MINEM, Mining Yearbook 2020

3.3.1. Mining exploration project portfolio

The 2022 Mining Exploration Project Portfolio report[5] comprises 63 projects with investments amounting to US$586 million. During the exploratory phase of mining projects, several requests for approval are submitted to the Environmental Management Instrument (EMI). While studies are carried out, more precise identification of mineralized deposits, expansion of the area of study or modification of components may be necessary. Table 2 presents projects under three stages.

A) EMI Assessment: the Environmental Affairs General Directorate (DGAAM) evaluates EMI approvals requests. All projects considered in 2021 have obtained EMI's approvals.

B) Exploration Authorization Assessment: following EMI's approval, the holder may submit an application for the Authorization to Begin Exploration Activities to the General Directorate of Mining (DGM) of the Ministry of Energy and Mines (MINEM).

C) Ongoing exploration or to be executed: Exploration Authorization granted by the General Directorate of Mining (DGM) enables to start exploration activities.

[5] Available online: www.minem.gob.pe/minem/archivos/file/Mineria/INVERSION/2022/CEM%202022.pdf

Table 2. Investment in mine exploration projects by stage of progress, 2021

Evaluation of environmental management instrument	Exploration Authorization Evaluation	Exploration underway or to be executed	
- Corvinón	- Bongará	- Alta Victoria	- Pablo Sur
- Crespo II	- Caylloma	- Amauta	- Palca
- Curibaya	- Cerro Negro	- Apacheta	- Paraíso
- Dorita	- Colorado	- Arcata	- Pucajirca
- Gabán	- El Carmen	- Azulmina	- Quehuincha
- La Zanja	- El Porvenir	- Carhuacayán	- Quenamari
- Las Defensas	- Huiñac Punta	- Chapitos	- Romina 2
- Lezard	- Lourdes	- Cochacuchi y Milagros	- San Antonio
- Loma Linda	- Mina Marta	- Cochaloma	- Santo Domingo
- Los Perdidos II	- Pampa Negra	- Coloso	- San Miguel
- Maria Cecilia dos	- Pucasalla	- Eposuyay	- Suyawi
- Miscanthus	- San José 1	- Huacullo	- Tumipampa Sur
- Quimsachata	- Santander	- Illlari	- Usicayos
- Riqueza	- Scorpius	- Iluminadora	- Yanacochita II
- Soledad	- Sombrero	- Llaguén	- Yauricocha
		- Lourdes	- Zoraida II
		- Malpaso II	

Source: Ministry of Energy and Mines (MINEM)

Cajamarca leads exploration at the national level with 21.5% of investments in 4 projects (US$126 million). The La Zanja (gold) project of Minera La Zanja S.R.L. represents 90.6% of the exploration budget in this region (see annex 2).

The Arequipa region ranks second with 15.2% of the exploration budget (US$89 million) in 8 projects. The Chapitos (copper) project of Camino Resources S.A.C. and the Caylloma (silver) project of Minera Bateas S.A.C. are the largest ones.

The Ancash region is in third place with 13.7% (US$80 million) of total exploration investment in 6 projects. The Soledad (copper) project of Chakana Resources S.A.C., the Coloso (gold) project of Huarmy Colosal S.A.C. and the Azulmina (zinc) project of Nexa Resources Perú S.A.A. are the most significant projects, accounting for 82.8% of the mining exploration budget in the region.

3.3.2. Mining construction project portfolio

The Mining Construction Project Portfolio[6] includes 43 projects with an overall investment of US$43.1 billion. Construction projects can be classified according to their stage of progress. Five projects are in the construction stage, with a joint investment of US$7 billion, which accounts for 13% of the Portfolio's overall investment. In this group, Shouxin Expansion (US$140 million) began construction in 2021, and Quellaveco (US$ 5.3 billion) has a start-up scheduled for 2022.

[6] Available online: www.minem.gob.pe/_publicacion.php?idSector=1&idPublicacion=642

Table 3. Investments underway in mine construction projects by stage of progress, 2021

Prefeasibility US$31.3 billion 59%		Feasibility US$10.4 billion 20%	Detailed engineering US$4.2 billion 8%	Construction US$7billion 13%
- Antilla	- Integración Coroccohuayco	- Pachapaqui Expansion	- Corani	- Santa María Expansion
- Ayawilca	- La Granja	- Chalcobamba Stage I	- Tía María	- Shouxin Expansion
- AZOD	- Los Calatos	- Conga	- Yanacocha Sulfuros	- Toromocho Expansion
- Cañariaco	- Los Chancas	- Magistral		- Ariana*
- Cañon Florida	- Macusani	- Ollachea		- Quellaveco
- Cotabambas	- Michiquillay	- Optimización Inmaculada		
- Don Javier	- Pukaqaqa	- Pampa de Pongo		
- El Galeno	- Quechua	- Planta de Cobre de Río Seco		
- Falchani	- Rio Blanco	- San Gabriel		
- Haquira	- Shalipayco	- San Luis		
- Hierro Apurimac	- Trapiche	- Zafranal		
- Hilarion	- Yumpag			

(*) The Ariana Construction Project owned by Ariana Operaciones Mineras S.A.C. is paralyzed.
Source: Ministry of Energy and Mines

Investments are located in 17 regions across Peru and are undertaken over several years (see annex 3). Cajamarca leads with 5 projects (US$18.1 billion; 33.9% of total investment). In the northern region, Yanacocha Sulfides stands out with construction expected to start in 2022.

Apurimac ranks second with 7 projects (US$10.2 billion; 19.2% of total investment). Hierro Apurímac, Los Chancas and Haquira stand out with US$2.9 billion, US$2.6 billion and US$1.9 billion respectively. In addition, construction of Chalcobamba Stage I (new pit in operation by Minera Las Bambas) is expected to start next year.

Moquegua region ranks third with 3 projects (US$6.4 billion; 12.0% of total investment). The largest one is Quellaveco; construction was launched in 2018 and is expected to be completed in 2022.

The investments to be executed in the construction of projects for the 2021-2025 period amount to US$10.3 billion representing 19.5% of the overall investment estimated in this Portfolio.

After 2025, the projected investments amount to US$39 billion, accounting for 73.4% of the overall investment.

During this period, the progress and definition of 28 projects is expected, with a joint overall investment amount of US$34.5 billion. This group includes relevant projects such as La Granja, with US$5 billion, and Pampa de Pongo, with US$2.6 billion.

3.5. Peruvian demand in the mining value chain

The main stages[7] in the value chain of the mining sector are the following ones:

- Exploration: it is carried out with the purpose of demonstrating the dimensions, position, mining characteristics, reserves and values of the mineral deposits.
- Exploitation: stage in which the minerals contained in a deposit are extracted. In the case of subway mining, it is common to drill, blast, haul and transport outside the mine (rails or wheels). In surface mining, the process includes drilling, blasting, loading and hauling.
- Beneficiation: consists of extracting or concentrating the valuable part of an uprooted mineral aggregate and/or smelting, purifying or refining metals, either through a set of physical, chemical and/or physical-chemical processes.
- Commercialization: consists of the sale of minerals. The practice of this activity is free; it does not require the granting of a concession.

The acquisition of goods or services by the mining companies depends on their stage of activity. For example, Antamina[8] mining company had commercial relations with 1,249 suppliers in 2020 and generated purchases for a value of US$1.1 billion from which US$1.05 billion were from domestic distributors and suppliers including US$38.6 million from 164 local Ancash suppliers.

Purchases from abroad amounted to US$69.6 million with the United States (39%), Chile (22%), Germany (14%), and 22 other countries. Antamina mining company has international freight agents to handle imports and to manage and receive the goods, which are transported by sea, land or air. In 2020, the mining company Cerro Verde[9] carried out operations with 1,526 local, national and international suppliers for an amount exceeding US$2 billion. Goods and services accounted for 48.3% and 51.7% respectively with 20.9% produced locally.

Purchases from foreign companies that have established a branch or exclusive distributor in Peru appear as national or local.

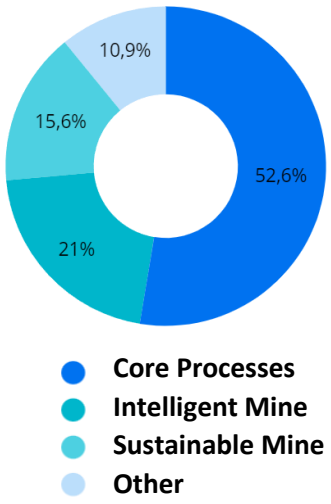
Acquisitions from foreign companies with a Peruvian corporate name facilitate the management by the mining company.

During the year 2020, the Linkminers[10] platform identified in its report "Analysis of Available Technologies for the Peruvian Mining Industry" 55 operational needs of various mining companies in Peru. These were categorized into:

[7] Available online: www.minem.gob.pe/minem/archivos/file/institucional/regionales/Publicaciones/Guia-Peque%C3%B1os-Artesanales.pdf
[8] Available online: https://25n9v12xdmru2v4k1z46yi4o-wpengine.netdna-ssl.com/wp-content/uploads/2021/09/sustainability-report-antamina2020.pdf
[9] Available online: www.cerroverde.pe/assets/img/publicaciones/mineria-cobre-molibdeno-arequipa-minera-cerro-verde-peru-reporte-2020.pdf
[10] Available online: https://datastudio.google.com/reporting/d02ea28c-f7f7-40ed-8557-4b2824ed31d6/page/Cx52B?s=qqhcMb2P6g4

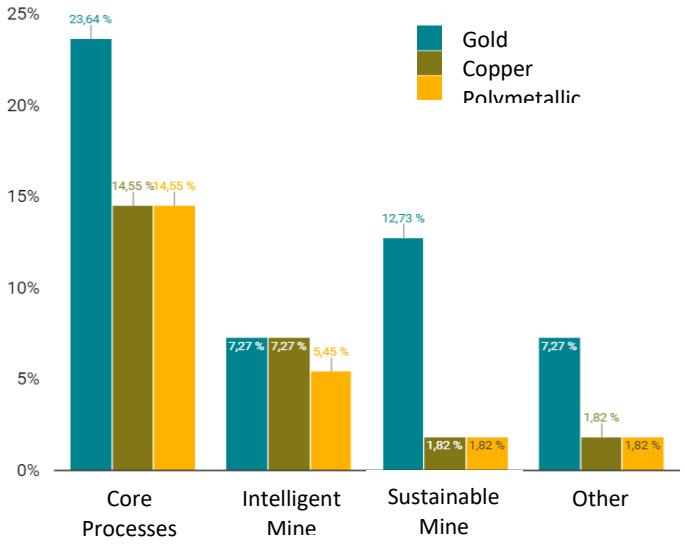
1. **Core Processes:** category with the highest number of needs aimed at generating efficiency, increasing productivity and modernizing central technologies in the operation and maintenance fronts.
2. **Smart Mine:** oriented towards the adoption of Industry 4.0 technologies with a focus on data-driven decision making and operations management.
3. **Sustainable Mine:** focused on adequate social management, working with communities and dealing with challenges related to the environment with a strong emphasis on decarbonization.
4. **Others:** focused on requirements more related to inputs, goods or services.

Figure 3. Structure of mining needs



Source: Linkminers

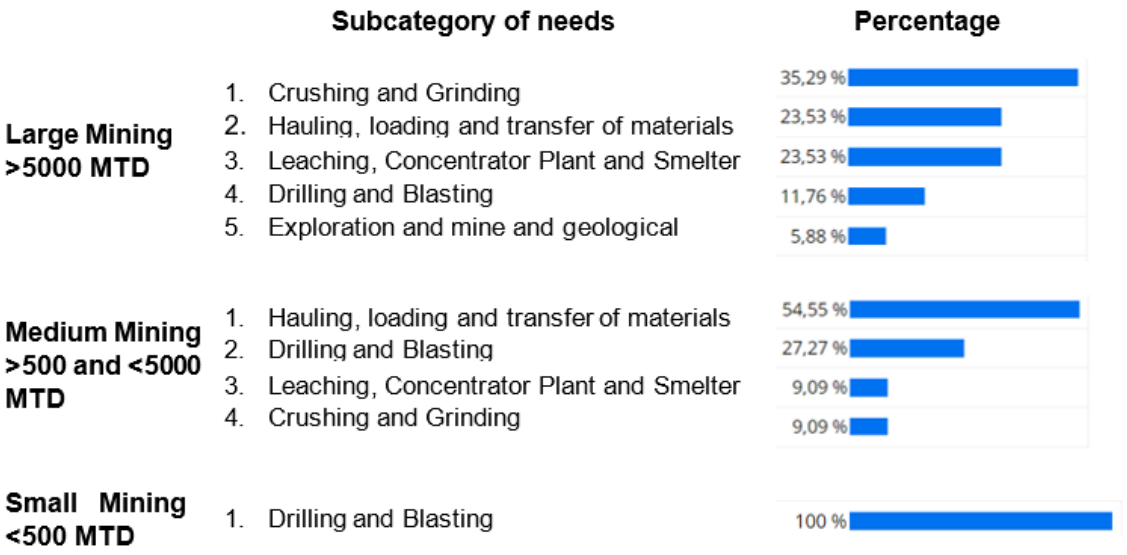
Figure 4. Needs classified by mineral type



Source: Linkminers

Approximately 50% of the needs come from mining companies that process gold. Out of the four categories, Core Processes registers the highest number of needs and requirements. For this reason, Linkminers subdivided this area into five subcategories to identify the fields of greatest interest based on the size of the mine (see figure 5). Further details on the goods and services needed by Peruvian mining companies are available in annexes 4 to 11.

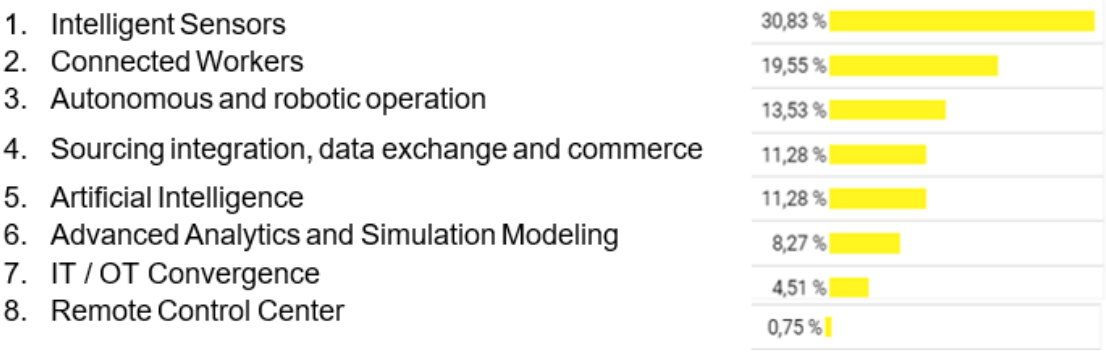
Figure 5. Core Process Subcategories



Note: metric tons per day (MTD)
Source: Linkminers

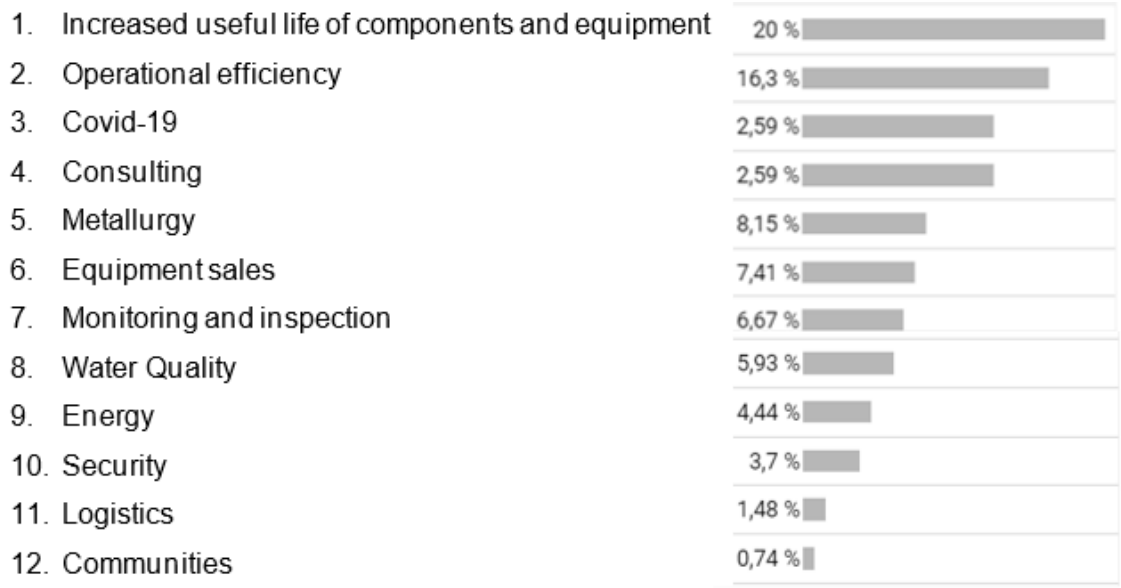
These needs reported by mining companies generated 268 solution proposals from suppliers from 15 countries, 78% of which are distributors of foreign companies in Peru. Fifty percent of the proposals included a digital component and half of them referred to "Core Process" needs incorporating smart sensor technologies. The "Smart Mine" and "Sustainable Mine" category needs induced mainly proposals with technologies that digitally connect workers. The non-digital solutions focused mainly on increasing the useful life of components and equipment, and operational efficiency.

Figure 6. Digital solutions



Source: Linkminers

Figure 7. Non-Digital solutions



Source: Linkminers

The first "Study of Mining Suppliers in Peru - 2021", carried out jointly with the Center for Competitiveness and Development and Linkminers[11], provides a baseline from which to define goals and objectives for mineral growth and development.

- Purchases by mining companies from suppliers amount to US$10 billion annually.
- 66% of the suppliers are located in Lima.
- 93% of the companies state that innovation is part of their business strategy.

202 mining companies participated in the survey identifying 7,839 suppliers. 64.9% of mining suppliers started their business in the last two decades, mainly as a result of the entry into operation of new mines and expansions that have increased copper production approximately fourfold.

The major supplier to the mining industry is the energy sector with electricity, gas and oil accounting for 23.3% of total purchases. Other important suppliers are transportation services (19.9%), metal mechanics (11.3%), chemical products (10.1%), financial services (8.8%), textile products (2.3%) and personal protective equipment (1.4%).

More than half of the suppliers (56%) are micro and small companies, 13% are medium-sized companies and 31% are large companies. Suppliers are mainly owned by national capital (81%), whilst foreign and mixed capital own mainly large firms representing 11.4% of the total.

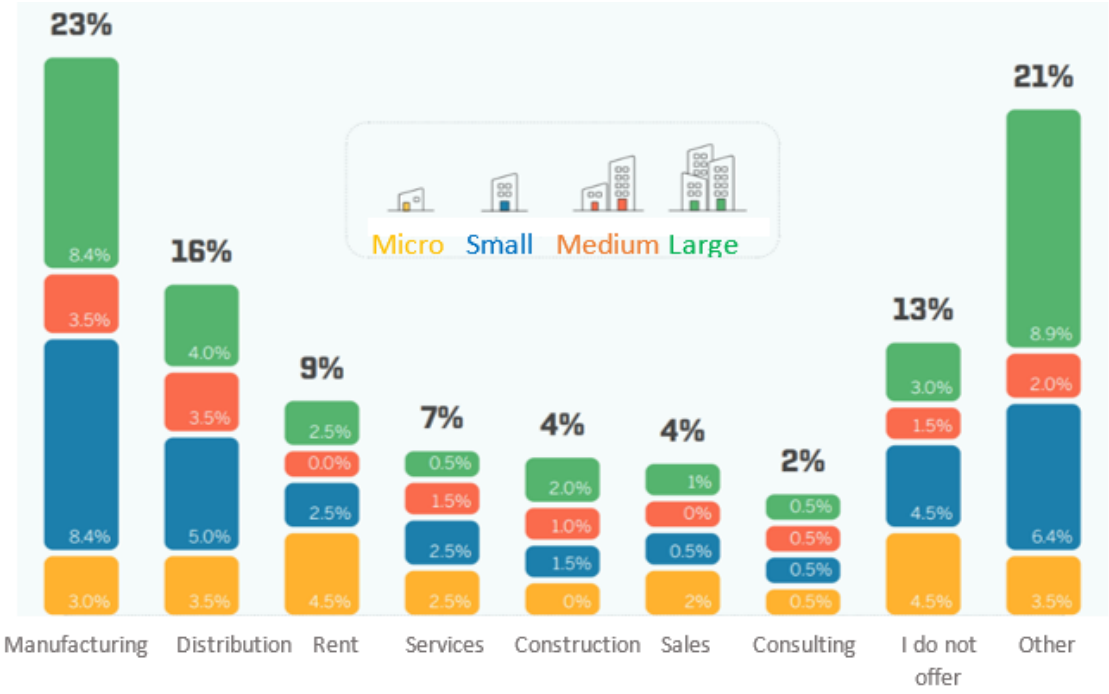
[11] Available online: www.sammi.pe/noticias/primer-estudio-de-proveedores-mineros-del-peru-2021

The mixed or foreign capital companies have funds mainly from Chile (37%), the United States (26%), Spain (18%) and Germany (16%). Switzerland has a 5% shareholding.

Study of Mining Suppliers in Peru - 2021

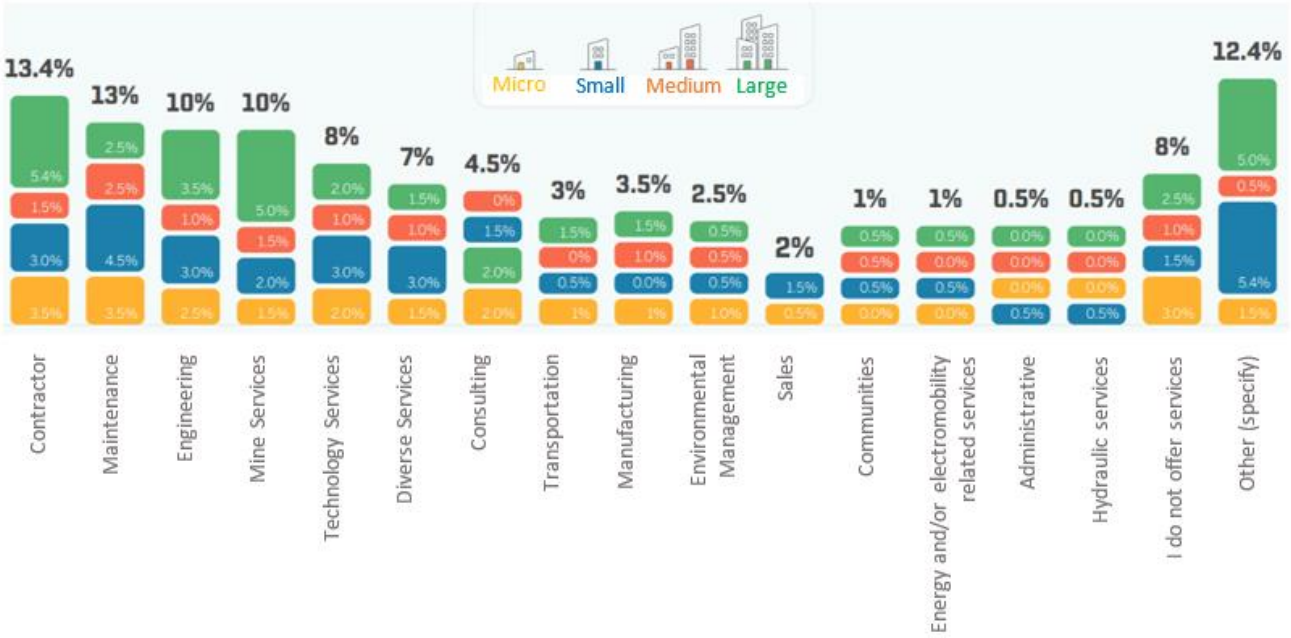
Companies that offer equipment specialize mainly in manufacturing (23%) and distribution (transportation of the mining products) (16%), while 13% do not offer equipment and focus only on providing services. The companies specializing in equipment are mainly companies with more than 20 years in the market and concentrated in medium and large companies (see figure 8). The companies offering services specialize mainly in contractors (13%), maintenance (13%), engineering (10%) and mine services (10%). Most of them have been in the market for more than 20 years. Maintenance, technology services, miscellaneous services, and consulting companies are primarily micro and small companies (see figure 9).

Figure 8. Equipment suppliers by industry or specialty



Source: Study of Mining Suppliers in Peru - 2021

Figure 9. Service providers by industry or specialty



Source: Study of Mining Suppliers in Peru - 2021

3.6. Illegal mining and informal mining

Peru has several ecosystems vulnerable to climate change. Illegal mining and informal mining affect the environment through activities such as logging and the use of mercury, as well as soil and water contamination. The damage is not only environmental, but also affects labor rights, health and social conditions of workers and the surrounding population. "Illegal mining" and "informal mining" are defined in Legislative Decree Nº 1105, which establishes the provisions for the formalization process of small-scale artisanal mining activities (see annex 1).

The main characteristics of illegal mining are:

- Lack of mining title
- Lack of surface access title
- Overlapping with other rights
- Lack of recognition as a small mining producer
- Acting without an environmental instrument
- Non-payment of taxes
- Non-compliance with labor and safety rights
- Others

Madre de Dios, a Department located in the Amazon region highlights the detrimental effects of illegal mining. This region has been for years the epicenter of illegal gold mining with the destruction of more than 25,000 hectares of one of the most biodiverse forests on the planet.

In Madre Dios, 70% of Peru's artisanal gold is produced and 70% of the economy is related to mining, but only 10% is legal. Eradicating illegal mining would create huge social problems; formalizing it would provide the region US$600 million in fiscal

revenues, according to calculations by the regional governor of Madre de Dios, Luis Hidalgo[12].

Informal mining is defined as mining activity carried out using equipment and machinery that do not correspond to the characteristics of the mining activity being developed (Small Mining Producer or Artisanal Mining Producer) or without complying with the administrative, technical, social and environmental requirements, or operating in areas not prohibited for mining activity and having initiated a formalization process (see annex 1).

Between 90-95% of informal mining is carried out in third party concessions, mainly on land belonging to communities. There are approximately 500,000 informal miners with REINFO (Integral Registry of Mining Formalization; General Directorate of Mining Formalization of the Ministry of Energy and Mines) according to data from MINEM and Mining Society. However, a large percentage of these non-working miners are not exclusively engaged in mining but are also farmers and ranchers. Peruvian legislation has been simplified but it is still complex for the artisanal miner[13].

> Between 2015 and 2019, Peru produced 720 tons of gold; however, in that same period, the country exported 2242 tons, which leaves almost 70% of its gold exports without production records.
>
> Organization of American States (OAS) Department Against Transnational Organized Crime (DTOC)

To be part of the mining formalization process[14], individuals and legal entities must be registered in the REINFO and comply with the following specific requirements subject to the Regional Mining Energy Directorates or Managements of the jurisdiction where the activity registered in the REINFO is located:

- Approval of the Environmental Management and Control Instrument for the Formalization of Small Mining and Artisanal Mining Activities - IGAFOM or of the Corrective Environmental Management Instrument - IGAC, when applicable.
- Proof of ownership or authorization of use of the surface land.
- Accreditation of ownership, assignment contract or exploitation contract with respect to the mining concession.
- Affidavit that replaces the Certificate of Non-existence of Archaeological Remains.
- Technical File.

Once these requirements are fulfilled, the DREM/GREM issues the authorization to start or restart mining activities of exploitation and/or mineral processing and/or processing concession title.

The comprehensive mining formalization process was extended until 2024.

[12] Available online: https://gestion.pe/peru/mineria-ilegal-en-madre-de-dios-estragos-y-remanentes-del-salvaje-oeste-peruano-noticia/?ref=gesr
[13] Available online: www.competitividadysostenibilidad.pe/Presentaciones/PPT-ANTONIO-SAMANIEGO.pdf
[14] Available online: http://pad.minem.gob.pe/REINFO_PORTAL/#:~:text=Proceso%20de%20Formalizaci%C3%B3n%20Minera,-1)%20%C2%BFC%C3%B3mo%20puedo&text=Acreditaci%C3%B3n%20de%20propiedad%20o%20autorizaci%C3%B3n,de%20Inexistencia%20de%20Restos%20Arqueol%C3%B3gicos

3.5.1. Better Gold Initiative

The Swiss State Secretariat for Economic Affairs and the Swiss Better Gold Association (SBGA) launched the Better Gold Initiative (BGI) in 2013, which was initially implemented in Peru and later expanded to Bolivia and Colombia.

The objective of the BGI is to contribute to the sustainable development of artisanal, small and medium-sized mining, creating gold value chains from the mine to the market and improving social and environmental conditions. In addition, this initiative connects demand in Switzerland (refiners, jewelers…) with responsible miners, and provides incentives for miners to improve their practices and comply with due diligence criteria or become certified through Fair Mining, Fair Trade or the Responsible Jewelry Council.

"The gold industry recognises supporting artisanal and small-scale gold mining as critical to responsible sourcing. By September 2021, the Swiss Better Gold Association, with the support of the Swiss government and the Swiss gold industry, have been able to export more than 8,000 kg of responsibly produced Swiss Better Gold and generate over US$5.6 million of impact premium for the benefit of participating Artisanal and Small-Scale Mining (ASGM) producers.

The Swiss Better Gold Association is delighted about the fast and positive growth of the initiative and looks very much forward to further expand its reach and support to ASGM producers' continuous improvements."

Olivier Demierre, President, Swiss Better Gold Association

September 6, 2021

The Responsible Gold Initiative encompasses social and environmental issues contained in the Fair Mining, Fair Trade or Responsible Jewelry Council certifications.

Accordingly, it complies with environmental protection standards focused on promoting environmental responsibility and minimizing negative impacts, as well as social standards related to improving labor conditions, protecting workers, and conducting due diligence in the supply chain.

4. REGULATORY OVERVIEW

Peru has legislation to promote social responsibility in business, labor, environmental and consumer areas. With respect to mining, Peru has also adopted a Tax Law and Energy Mining Law. It is important to specify that mining companies are not exempt from import duties, but can benefit from temporary import reductions with different rates depending on the type of product.

The legal framework that promotes and facilitates business between Peru and Switzerland is based on:

- The Agreement between the Republic of Peru and the Swiss Confederation on the Promotion and Reciprocal Protection of Investments (1991).
  Available online: https://investmentpolicy.unctad.org/international-investment-agreements/treaty-files/2163/download (English)
- The Free Trade Agreement between the Republic of Peru and the European Free Trade Association (EFTA) States.
  Available online:
  www.acuerdoscomerciales.gob.pe/En_Vigencia/EFTA/Documentos/ingles/Acuerdo_Principal.pdf (English)
- The Convention between the Republic of Peru and the Swiss Confederation for the avoidance of double taxation with respect to taxes on income and wealth and its protocol (2012).
  Available online:
  www.mef.gob.pe/contenidos/tributos/cv_dbl_imp/Convenio_Peru_Suiza_DT.pdf (Spanish)

Corporate Social Responsibility (CSR) is defined as all the efforts of the corporate sector that focus on achieving sustainable development considering economic, social and environmental criteria through different management tools. CRS was reflected in 2000 in the Ten Principles of the United Nations Global Compact, a list that includes human rights, labor, environment and anti-corruption. In the same year, the International Labor Organization (ILO) made the second amendment to the Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy. In 2015, the United Nations approved the 2030 Agenda for Sustainable Development, which includes 17 Sustainable Development Goals (SDGs).

The national regulations include aspects such as Corporate Law, Constitutional Law, Labor Law, Securities and Commercial Law, Tax Law and Mining and Energy Law as part of social responsibility (MINEM, 2014). The main standards on Social Responsibility in Peru establish the necessary criteria for the following areas: Corporate, labor, environmental and consumer.

4.1. Custom tariffs

Peru currently applies the following tariffs upon imports: (a) ad valorem tariffs of 0%, 6% and 11%, and (b) specific tariffs. There is a 0% tariff on 69.9% of tariff lines, which in 2018 accounted for 74% of imports in terms of value (WTO, 2020)[15].

[15] World Trade Organization (5 February 2020) Trade Policy Review Body - Trade Policy Review - Report by Peru - Revision. Available on line:
https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/WT/TPR/G393R1.pdf&Open=True

The Free Trade Agreement between Peru and the States of the European Free Trade Association (EFTA), of which Switzerland, Liechtenstein, Norway and Iceland are members, was signed in Reykjavik on June 24, 2010 and in Lima on July 14, 2010. According to this agreement, all those products that present a certificate of origin[16] will benefit from 100% liberalization of the Ad Valorem tariff.

Mining companies are not exempt from import duties but may benefit from temporary import tariff reductions. In addition, customs legislation allows the temporary importation, for a period of 18 months of certain capital goods without payment of customs duties and import taxes (e.g., machinery and equipment)[17].

4.2. Regulatory requirements

All the mining activities are regulated by the TUO (Unified Ordered Text) of the General Mining Law[18]

- **Research:** It is the first stage of mining. It will allow research procedures in the area of interest by simple methods. It does not require a concession or an environmental permit (Article 1 and 2 of the General Mining Law).
- **Prospecting:** It is also included in the first stage of mining and refers to carrying out research in the area of interest using sophisticated and/or technological (via satellite, geophysics, and geochemistry) methods. Prospection does not require a concession or an environmental permit (Article 1 and 2 of the General Mining Law).
- **Exploration:** It refers to demonstrating the dimensions, position and characteristics of the mining deposits. Exploration requires a concession and a semi-detailed Environment Effect Investigation, EIA (Article 8 of the General Mining Law).
- **Development:** It is the operation or set of operations carried out to make possible the exploitation of the ore contained in a deposit. Development requires a concession (Article 8 of the General Mining Law).
- **Exploitation:** It refers to the extraction of minerals from the mining deposit and can be carried out in two ways: underground - sinkhole- and in the open pit surface. Requirements include a concession and a series of permits (Environment Effect Investigation Detailed, water use permit, authorization of discharge and dumping of water, global authorization of explosives, direct consumer of liquid fuels and others) (Article 8 of the TUO of the General Law Mining).
- **Benefit:** It is the set of physical and chemical operations necessary to concentrate the valuable parts of minerals and/or to purify, melt or refine metals. It requires a concession (art. 17 of the TUO of the General Law of Mining).
- **General Labor:** It refers to auxiliary services such as ventilation, drainage, lifting or extraction. (Articles 19, 20 and 21 of the TUO of the General Mining Law).
- **Mining Transport:** Mass transport of mineral products by girdles conveyors, pipes or cable rails. The transport activity requires a concession (Articles 22 and 23 of the TUO of the General Mining Law).
- **Commercialization:** The purchase and sale of minerals in the national and international market do not require a concession. (Articles 3 and 4 of the TUO of the General Mining Law).

[16] The document that certifies compliance with the origin requirements, in accordance with the provisions of the corresponding trade agreement or preferential regime.
[17] Available online: www.bancomundial.org/es/country/peru/publication/diagnostico-del-sector-minero-peru
[18] Available online: www.minem.gob.pe/minem/archivos/file/Mineria/LEGISLACION/TUO%20.pdf

- **Storage of Mining Waste:** the owner of a mining concession must store waste in deposits located outside the areas of mining operations. He is responsible for the management, storage and handling of such concentrates, as well as emissions, discharges, noise, handling and final disposal of solid waste, and disposal of waste to the environment that is produced in its installations (Articles 2 and 5 of the Legislative Decree N° 1048)[19].

Regarding technology in the mining sector in Peru, there is a Supreme Decree that approves the Technology Roadmap for Mining Technology Suppliers and establishes a temporary Multisectoral Commission (D.S. N° 008-2021-PRODUCE)[20]. Not yet published, this Supreme Decree has the following objectives:

1. Create, develop and consolidate models of associativity among mining suppliers, in order to strengthen the union nationally and internationally.
2. Consolidate a standard of policies and procedures in health, safety, environmental and quality management control for mining suppliers.
3. Collaborate with the articulation of solutions together with the mining companies and the State to promote the inclusion of the inhabitants of the mining regions in the mining value chain, contributing to the development of the region and the improvement of their quality of life; with emphasis on the use of clean and/or mercury-free technologies.

4.3. Mining Tax Law

1. Special Mining Tax

Law N°. 29789 (2011) creates the Special Tax on Mines (IEM), which levies utility obtained of the mining activity, coming from the sales of the metallic mineral resources in the state in which they are found, as well as that coming from self-consumption and unjustified withdrawals of the referred goods. It includes the holders of mining concessions and the assignees who carry out activities of exploitation of metallic mineral resources. The operating profit of the subjects of the mining activity is the result of deducting from the income generated by the sale of mineral resources carried out in each calendar quarter, considering the division of the quarters into January-March, April-June, July-September and October-December; the cost of sales and operating expenses, including selling expenses and administrative expenses, incurred in generating such income[21].

2. Mining Regalia

Law N°. 29788 - Mining Royalties Law (GEM) (2011), defines mining royalty as the economic consideration that the subjects of the mining activity pay to the State for the exploitation of metallic and non-metallic mineral resources. Unlike the IEM, the GEM is a resource that the State receives not only for the exploitation of metallic minerals, but also non-metallic ones. Also, the foundation of the mining royalty is no longer state power, but the civil obligation called consideration. The royalty will be calculated on the operating profit of the subjects of the mining activity. Likewise, the moment of the

[19] Available online: www.minam.gob.pe/wp-content/uploads/2017/04/DLeg-1048.pdf
[20] Available online: https://busquedas.elperuano.pe/normaslegales/decreto-supremo-que-aprueba-la-hoja-de-ruta-tecnologica-para-decreto-supremo-n-008-2021-produce-1936495-1/
[21] Available online: www2.congreso.gob.pe/sicr/cendocbib/con4_uibd.nsf/B488007B66BDA11305257C200057CCF0/$FILE/29789.pdf

obligation of the mining royalty is also determined quarterly, being that this is established in function to operating margin for the quarter[22].

3. Mining Lien

Law N°. 29790 - Special Tax on Mining states that mining resources are an original public resource, this is why there is a reason for payment the State's exploitation of its own resources. In terms of operation, it is applicable to the subjects of the mining activity in merit and from the signing of agreements with the State, regarding projects for which Guarantee Contracts and Investment Promotion Measures remain in force[23]. The basis for calculating the tax corresponds to the quarterly operating profit, which is determined by each of the Guarantee Contracts signed by the subjects of the mining activity, as indicated in article 3[24].

4. Support Regulation

Law N°. 27332 - Framework Law of the Regulatory Bodies for Private Investment in Public Services, published in 2020, states that the Regulatory Bodies will collect from the companies and entities under their purview, a contribution by regulation, which may not exceed 1% of the value of its annual billing, deducting the General Sales Tax (IGV) and the Municipal Promotion Tax (IPM). Likewise, it was provided that said contribution will be fixed by means of a supreme decree[25].

Currently, companies in the mining sector are subject to two contributions, which will be referred as "Contributions" together, they are the Contribution by Regulation of the Supervisory Agency for Energy Investment (OSINERGMIN) and the Contribution by Regulation of the Energy Investment Agency, Environmental Assessment and Enforcement (OEFA).

Now, through Supreme Decree No. 200-2019-PCM[26], the 2022 aliquot of the Contribution by Regulation to OSINERGMIN was approved, which amounts to 0.14% and is calculated on the value of the monthly billing recorded in the Registry of Sales and Income, which corresponds to activities directly related to the scope of its supervisory and auditing competence. On December 31, 2019, Supreme Decree No. 203-2019-PCM[27] was approved, which establishes provisions on the OEFA Regulation Contribution for the 2020-2022 period. Thus, it was reiterated that the regulated entities are the owners of the Large and Medium Mining activities. Likewise, the 2022 rate was approved, which amounts to 0.10% and is calculated on the monthly billing recorded in the Sales and Income Registry.

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[22] Available online: www.minem.gob.pe/minem/archivos/file/Mineria/LEGISLACION/2011/SETIEMBRE/LEY%2029788.pdf
[23] Available online: www.leyes.congreso.gob.pe/Documentos/ExpVirPal/Normas_Legales/29790-LEY.pdf
[24] Available online: www.mef.gob.pe/en/por-instrumento/decreto-supremo/8372-decreto-supremo-n-173-2011-ef/file#:~:text=Para%20efecto%20del%20presente%20Reglamento,entender%C3%A1%20referido%20al%20presente%20Reglamento
[25] Available online: https://cdn.www.gob.pe/uploads/document/file/722426/Ley-27332.pdf
[26] Available online: www.osinergmin.gob.pe/seccion/centro_documental/PlantillaMarcoLegalBusqueda/DS-200-2019-PCM.pdf
[27] Available online: https://busquedas.elperuano.pe/download/url/establecen-disposiciones-sobre-el-aporte-por-regulacion-del-decreto-supremo-n-203-2019-pcm-1841829-3

5. OPPORTUNITIES AND CHALLENGES

Mining is the most important export sector in the Peruvian economy offering significant business opportunities to Swiss firms. They have a significant potential in innovative cleantech products and solutions to strengthen the sustainability of mining economies. Several Swiss firms are presently active in Latin America or interested to enter the market. Their potential contributions in meeting key challenges are highlighted. Doing Business in Peru raises important challenges and risks at the administrative and political levels.

The value chain in Peru seeks products or services whose objective is to generate efficiency, increase productivity and modernize central technologies in operation and maintenance. Swiss firms have a significant potential in innovative products and services contributing to Peru's cleantech footprint.

5.1. Mining opportunities

In Peru, suppliers' share of the mining sector in GDP is 4%.

Benjamín Quijandría, consultant of the Development Bank of Latin America (CAF).

The mining sector's purchases from domestic suppliers (also includes importing companies established in Peru) fell in 2020 to US$8.9 billion, due to the Covid-19 recession, to recover in 2021 to US$10.3 billion (similar to the 2019 level with US$10.4 billion), according to estimates by the Institute of Mining Engineers of Peru (IIMP). According to projections, if the mining investments in the pipeline (>US$56.2 billion of which 49% are in the southern zone) are completed, the sector's purchases from domestic suppliers would rise to US$23.7 billion in 2031. Among them, gas and electricity, services and transportation goods, metal-mechanic products and chemical products stand out[28].

5.2. Access to business opportunities

Suppliers in the value chain must communicate with mining operations.

73% of mining companies have sections on their websites for direct contact and important information for their suppliers.

Normally, mining companies conduct product searches within their current suppliers or seek external sources such as local mining directories or international platforms.

Source: EY Global Risk Survey, 2021.

The Institute of Mining Engineers of Peru (IIMP) generates an annual IIMP Suppliers Guide in digital and printed format. The 2022 edition has the following seven sections: Peruvian mining, mining projects portfolio, directory of products and services, directory of contractors and consultants, directory of related institutions, main mining companies in Peru and, innovation and Covid-19.

[28] Available online: https://iimp.org.pe/raiz/este-ano-compras-de-mineria-a-proveedores-nacionales-llegarian-a-us$-10,300-millones

The IIMP Suppliers Guide 2022 can be accessed with the following link: https://iimp.org.pe/brochure/guia/proveedores/IIMP-2022

Mining companies procure thousands of products and numerous services ranging from the operational to the administrative fields. Linkminers' categories provide a good reference to differentiate four large groups of needs: a) Core processes (which has five subcategories: 1. Hauling, loading and transfer of materials; 2. Crushing and grinding; 3. Exploration and mine and geological planning; 4. Leaching, Concentrator plant and smelter and 5. Drilling and blasting); b) Smart mine; c) Sustainable mine, and d) Others.

Table 4. Classification of opportunities for some Swiss companies

Core Processes	Smart Mine	Sustainable Mine	Other
Sulzer	ABB	Ganser	SICPA
Sika	Argor Heraeus	Soleol	
Geobrugg		Endress+Hauser	
Geotest			
Marti			
Hilti			
Leica			
Wyssen Avalanche			

1. Opportunities in Core Processes

Among Swiss companies, seven were identified holding a strong position under core processes to offer solutions for mining operations and maintenance, which leads to modernize technologies, improve efficiency and increase productivity. Many of the needs involve challenges for which mining companies seek innovative solutions. Over the last few years, Linkminers has identified these challenges. The seven Swiss companies can provide the following contributions:

Sulzer can contribute to water-related solutions in the subcategory Leaching, Concentrator plant and smelter through improving water recovery in tailings thickeners.

Sika can provide solutions in Drilling and blasting, i.e., in reducing overburden in subway mining advance workings and Optimization of drilling and blasting process in subway mining.

Geobrugg, which has a presence in Peru, several years of experience and an intense collaboration with universities and research institutes, is a reliable partner for safety and security solutions. In Hauling, loading and transfer of materials, Geobrugg can contribute with Anti-rock fall systems as well as **Wyssen Avalanche**.

In Exploration and mine and geological planning, **Geotest** can meet the needs of drones for topographic surveys and orthophotos. With its drone fleet and terrestrial digital cameras, Geotest generates professional terrain and object imagery. Based on photogrammetric analyses, Geotest can propose solutions to a wide range of problems on request.

Marti, a construction company specialized, among other things, in earthworks, special works, sawing and drilling has the potential to provide solutions to the challenges in Drilling and Blasting: Real time visualization of the bottom of the long borehole pit; Drilling

and blasting service for waste dump project, Drilling of waste rock pits, Optimization of drilling and blasting process in subway mining, Instrumentation to measure temperatures inside drill holes and Reducing the deviation of long drill holes to less than 2%.

Finally, in Exploration and mine and geological planning, **Leica** can contribute to the following needs: Adaptation of "LIDAR" technology in topography drone. The key to revealing the hidden surface geology is a powerful multipulse airborne laser scanner, or LiDAR. McElhanney Consulting Services Ltd. de Vancouver, B.C., Canada, which owns three Leica Geosystems LiDAR scanners and two Leica Geosystems ADS digital cameras, initiated the lineament mapping project using the Leica ALS60 and is upgrading to the more powerful 500 kHz ALS70-HP system.

Linkminers has identified 45 different needs in the Hauling, loading and transfer of materials subcategory (subcategory with the most opportunities) that Peruvian mining companies need to satisfy. Some companies are looking for solutions to reduce fuel and CO_2 emissions, to detect fatigue and drowsiness in concentrate transport drivers and to monitor vital signs and measurement of operator sleep quality KPIs.

Core Processes: Identified new Business opportunities

- Controlled demolition of reinforced concrete walls of great thickness
- LED signage for haulage roads
- "Inchancables" detection system (materials that cannot be demolished)
- Oursourcing: Ore selectivity at the loading stage (sensors on shovels)
- Simulation of mining operations - Loading and haulage processes
- Implementation of IoT system to determine driving profiles
- Remote Operation of Rock Breakers
- Isamill stoppage prediction using Machine Learning
- Training in Machine Learning with geological applications (Advanced Analytics)
- Predictive maintenance service to gold processing plant

To learn more about the other opportunities in the Core Processes category (197 opportunities), you can review annexes 4 through 8.

2. Opportunities in Smart Mines

With respect to smart mines, one Swiss company among others was identified as providing presently technological solutions to the challenges faced by mines in Peru.

ABB has a presence in Peru with offices in Lima and Arequipa. ABB has a complete portfolio of industrial technology products for utility, industrial, transportation and infrastructure customers. ABB can satisfy the following needs identified by Linkminers: Automation of water management pumping system; Automation, process control and electrical maintenance services and Data transmission from the underground to the surface.

Another important area is Machine learning. Autonomous vehicles and robotic process automation are key to the ongoing revolution in mining operations. This will make mining tasks safer. This will also mean reduced labor costs and improved safety and productivity.

The global health crisis also spurred a change in corporate culture leading to a transformation in the workforce. Ensuring worker safety during the pandemic has led companies to accelerate the adoption of remote and virtual work teams.

In that sense, digital and data optimization represents a great opportunity to improve efficiency of a mining company and of the various companies involved in its value chain. The recourse to various technologies, such as automation, artificial intelligence and blockchain, to help ensure business continuity, is now indispensable in companies' long-term strategies.

In the Smart Mines category, there are 29 different business opportunities, among which we can highlight the need for personnel monitoring devices, intruder alert systems, electric pick-up trucks for mining operations, etc.

Smart Mines: Identified new Business opportunities

- Identification and quantification of mineralogical species online
- Implementation of devices in trucks for dashboard visualization
- Technological renovation of the mine's interior communications system.
- Detection of excavator GETS loss through Video Analytics
- Implementation of augmented reality in mine and plant maintenance works.
- Electric pick-up trucks for mining operations.
- Intelligent Dashboard for monitoring and control of plant and mine equipment
- Electronic device for wireless lamp for tracking people
- Aerial monitoring and alert of personnel detection in restricted areas
- Implementation of a platform for concentrate fleet management

To learn more about the other opportunities in the Smart Mines category, you can review annex 9.

3. Opportunities in Sustainable Mining

Among Swiss firms, three firms were identified to contribute to sustainable mining.

Ganser has developed a Common Rail injection technology, which contributed significantly to the new era of the modern diesel engine. It can also be applied to the large trucks operating in the mines. Ganser’s main contributions to the challenges identified by Linkminers are: Reducing carbon footprint for fuel for mobile equipment in the mine and energy efficiency.

Soleol's specialization in solar energy allows to produce ecologically electricity and to install Photovoltaic power generation systems.

Water treatment also plays a critical role in mining operations because a constant supply of clean water is crucial for processes such as separation. Wastewater treatment is equally complex. These challenges are greater when working in a remote location. **Endress+Hauser's** technologies offer multiple solutions for water treatment in a mining plant.

An important opportunity in the sector relates to sustainability (decarbonization and green programs), which is part of a long-term strategy linked to corporate social responsibility. In Peru, there has been significant progress in establishing standards on social responsibility and it is vital to continue in this direction. Reducing greenhouse gas

emissions will encourage companies to develop more efficient approaches to achieve lower emissions.

In the Sustainable Mines category there are 22 different business opportunities identified between 2020 and 2021, some of them include the need for Desalinization of water and Identification of water wells.

Sustainable mining: Identified new Business opportunities

- Improve tailings dam dam construction process
- Particulate matter measurement equipment for smelter chimney
- Search for efficient methods and/or efficient treatment of tailings
- Desalinization of water for a continuous flow of 100-150 m3/day
- Identification of water wells
- Measurement of flow rates in open channels
- Covid-19 sanitation
- Drones, cabins or other mechanism for sanitization of mining operation
- Environmental monitoring
- Implement a control system for social projects

To learn more about the other opportunities in the Sustainable Mining category, you can review annex 10.

4. Other Opportunities

Finally, in the last group, **SICPA** offers services to improve traceability in the mine for resources and processes.

For traceability of gold purchased in mining countries, **Argor Heraeus** uses blockchain, DNA marking or equivalent technologies by affixing a distinctive sign on the bars, or physically tampering with doré bars, which are then analyzed in Switzerland, confirming their origin.

Other Opportunities: Identified new Business opportunities

- Improve in-plant lock out tag out management
- Improve communications in the face of radio signal saturation at the mine site
- Fast and efficient methods for disinfecting truck cabins
- Inbound logistics management, planning, control and monitoring platform
- Warning systems in self-rescue zones
- Development of seismic early warning system
- Air purifiers for administrative offices
- Remote soil moisture and soil compaction measurement
- Alternatives for alcoholtesting to avoid covid exposure
- Firefighting system for natural gas line

To learn more about the other opportunities in this category, you can review annex 11.

In order to meet United Nations environmental policy objectives, it is necessary to increase the use of some metals. For instance, according to Goldman Sachs, global copper demand is stimulated by the clean technology production chain: "No decarbonization without copper". The ecological transition puts pressure on copper

demand, but markets are not prepared to produce on this scale. However, between 2010 and 2019 copper production in Peru grew by 97%, which provides optimal conditions to supply mining companies with equipment and other goods and services.

5.3. Minergy Scouting

The National Society of Mining, Petroleum and Energy is the most important guild that brings together more than 140 companies in the mining and energy sector in Peru. In 2021, its Technology and Innovation Committee launched its first international open innovation program with the most relevant entities of the public and private sectors, directly related to mining and energy.

Minergy Scouting[29] seeks to accelerate the technological transformation of extractive industry in Peru offering to the best technology providers in the world the opportunity to present innovative and modern solutions to the challenges faced by mining and energy companies. The challenges addressed by this program are as follows:

- Community Relations: solutions to have the best practices at the corporate level and with the communities in the areas of influence.
- Environment: solutions that contribute to the sustainable development of the sector.
- Operations: mechanisms to increase the efficiency of processes at the operational level.
- Productivity: alternatives to improve processes in order to increase the productivity indicators.
- Occupational safety and health: proposals to guarantee health and well-being.

The second edition of this program will take place in 2022. Swiss companies will have the opportunity to establish commercial relationships and / or to do business with the largest companies in the country's energy and mining sector.

5.4. Challenges to do business in Peru

Peru offers a framework for trade and investment characterized by administrative procedures often somewhat complex. According to the World Bank's 2020 "Doing Business" report[30] Peru is ranked 76th overall. Economic actors face significant challenges in doing business in Peru.

- Starting a business is a bureaucratic process (133th rank). It takes around 24 days and eight procedures to set up a business. The heaviest procedures are the deed of incorporation before a notary public and file it online with the Public Registry (SUNARP), which takes 8 days, and obtaining a technical inspection of building safety (ITSE) and the operating license (15 days). If the shareholders are from abroad, the incorporation process usually takes much more time.

- Doing Business report ranks Peru 121st for paying taxes. It involves eight payments per year and 260 hours. Profit (22.7%) and labour (11%) taxes are the main ones, with corporate tax at 29.5%. VAT (Value added tax) is added to most goods for sale, particularly imported items. The rate is 18%; imported goods may then turn out to be quite expensive.

[29] Available online: www.minergyconnect.pe/en/scouting-snmpe

[30] Doing Business 2020 is the 17th in a series of annual studies investigating the regulations that enhance business activity and those that constrain it. Doing Business presents quantitative indicators on business regulations and the protection of property rights that can be compared across 190 economies. Available online: https://espanol.doingbusiness.org/content/dam/doingBusiness/country/p/peru/PER.pdf

- Trading across borders is a slow and expensive process (102th rank). The time required for border compliance is 72 hours with a cost of US$700 and 48 hours with a cost of US$80 for documentary compliance.

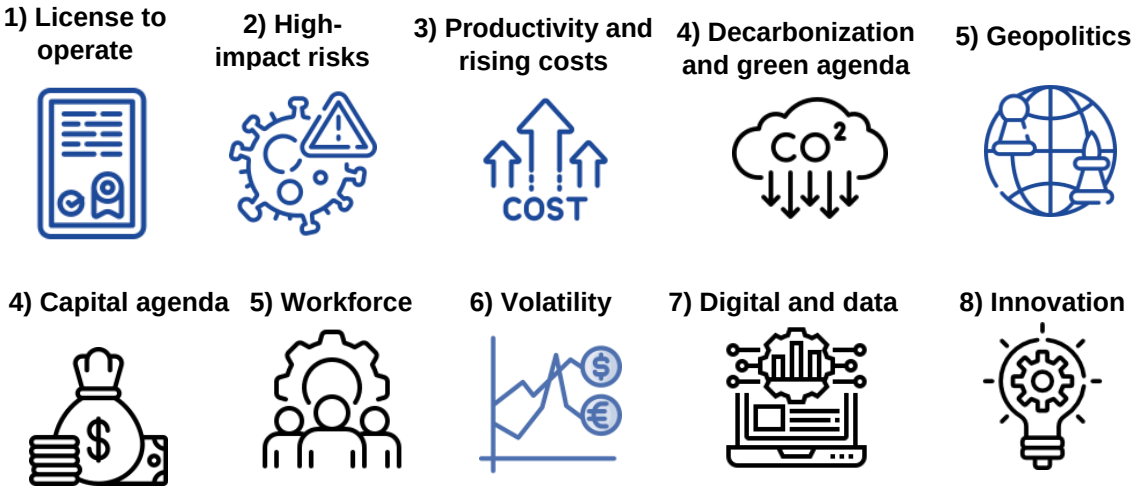
Macroeconomic policy is one of Peru's strength with a rigorous monetary and fiscal policy over many years. This has contributed to achieving one of the highest growth rates in Latin America during the past decade. However, the current political situation, characterized, among other things, by constant changes of ministers, has generated uncertainty for business. This political landscape embodies risks that may discourage investment and business, slowing down the growth of the economy.

In Peru, corruption is a very big issue. The most famous case involves a large Brazilian construction company, which admitted paying bribes in various countries in Latin America, including Peru. Peruvian legislation recognizes the corporate criminal liability applicable to bribes, so companies need to maintain open, honest and compliant business practices which are fully transparent with the law.

Foreign firms are being forced to forego important business opportunities because they refuse to make illicit payments to officials of public institutions.

In 2021, Ernst & Young[31] has identified the top 10 business risks and opportunities in mining and metals that can generate significant challenges in the sector worldwide. Considering that Peru is strongly linked to the global economy, we will highlight the elements that may represent a risk or opportunity in Peru.

Figure 10. Top 10 business risks and opportunities for mining and metals, 2021



Source: EY, Business risks and opportunities 2021

The main risk for Peru is the Mining License to operate. In Peru, the social contribution and the value derived from the mining sector are of vital importance since environmental care is usually the primary aspect for granting licenses.

73% of respondents stated that the impact of their companies on the local community is the issue that is most scrutinized by investors.

Source: EY Global Risk Survey, 2021.

[31] Available online: www. ey.com/es_pe/mining-metals/top-10-business-risks-and-opportunities-for-mining-and-metals

The experience gained by firms from the Covid-19 pandemic has highlighted the importance of preparing for economic uncertainty and COVID-19 related expenditures, which have generated cost pressures. Supply disruption have a major impact on productivity, representing a major challenge.

There are also geopolitical risks stemming from the global power struggle, mainly between the United States, China and the European Union as well as from the war between Russia and Ukraine.

These changes in global dynamics and the war in Europe have an influence on the mining sector with presently a strong increase in prices and concerns about supplies.

Other elements to consider are capital management, i.e., finding the balance between prudent spending and riskier investment decisions (with higher returns).

Overall, Swiss suppliers of goods and services can contribute significantly to four of the 10 business risks and opportunities with namely address rising costs by improving productivity, promote a green agenda by decarbonizing the environment, increase efficiency with digital data and automation and bring forward innovations.

6. IMPORTANT MARKET PLAYERS

Peru's mines purchase yearly US$10 billion to more than 7000 suppliers ranging from small to large firms. Innovation as well as participating in collaborative projects with mining companies are very important. 4.0 technologies play a growing role in mining with remote monitoring, automation and data analytics. There is a strong international competition for machinery. Through its regulatory power, the government plays an important role for mining companies and their suppliers.

Peru and some of its major players take an active part at some important global initiatives[32]:

- Peru is one of two Andean countries that are members of the Extractive Industries Transparency Initiative (EITI) and has made significant progress in transparency and governance[33].

- The International Council on Mining and Metals (ICMM) member association includes among its members one Peruvian mining company - Minsur - and two entities - the National Mining, Petroleum and Energy Society (SNMPE) and the Mining Safety Institute (ISEM)-. ICMM has developed initiatives to report on sustainability aspects associated with the supply chain of its members.

- Although Peru is not a member of the OECD, it adheres to its Guidelines for Multinational Enterprises. In the framework of the Country Program aimed at promoting adherence to OECD instruments, Peru issued Supreme Law No 005-2017 approving the Action Plan to implement the Recommendations of the Environmental Performance Assessment of Peru. Chapter XII details the mining sector and includes the recommendation to advance in promoting greater transparency of the environmental and human health effects of mining activities, among other things.

- Two Peruvian copper mining companies have the authorization to trade on the London Metal Exchange (LME), Southern Peru Copper Corporation and Sociedad Contractual Minera Cerro Verde, along with one lead mining company, Doe Run Peru S.R.L., and two zinc mining companies, Doe Run Peru S.R.L. and Nexa Resources Cajamarquilla S.A. As a result, these companies will have to submit to the LME's "Responsible Supply Chain" project currently under development.

- Peru currently is the only Andean country with a FairTrade certification for the MACDESA gold mine.

- Four Peruvian mines have a Fair Mining certification: CECOMIP, MACDESA, Oro Puno and San Luis, as a result of Alliance for Responsible Mining's (ARM) ongoing support to small and artisanal miners.

- The Embassy of the Netherlands in Peru and Solidaridad presented the Integral Small-Scale Mining Platform (PIM) in April 2019, being the first collaborative platform that promotes the development of responsible and formal mining. PIM focuses on implementing sustainability and traceability systems to develop technical, legal, social, environmental and economic standards by supporting Fair Mining, Fair Trade or Responsible Jewelry Council certifications.

[32] Available online: https://repositorio.cepal.org/bitstream/handle/11362/45604/1/S2000305_es.pdf
[33] Available online: https://eiti.org/

6.1. Buyers: major mines

The largest mines are the main buyers in the mining value chain. In 2021, AméricaEconomía[34] magazine has published a ranking of the 500 largest companies in Peru, with three mining companies in the top 15.

Table 5. Top 15 largest mining companies in Peru, 2021

Mining sector	Ranking 2021	Name of the company	Revenues US$ MM 2020	Address	Email	Phone number
1	4	Southern Peru Copper Corp. Sucursal del Perú	3,153.60	Av. Caminos del Inca 171 Urb. Chacarilla del Estanque, Santiago de Surco - Lima	-	(511) 512-0440
2	8	Cía. Minera Antamina	2,797.70	Av. El Derby #055 Edificio Cronos Torre 1 Piso 8, Santiago de Surco - Lima	comunicaciones@antamina.com	(511) 2173000
3	10	Sociedad Minera Cerro Verde	2,538.60	Av. Alfonso Ugarte 304 - Arequipa	smcv@fmi.com	(51) 54 381515
4	18	Minera Las Bambas	1,775.30	Av. El Derby #055 Edificio Cronos Torre 3 Piso 9, Santiago de Surco - Lima	comunicaciones.LasBambas@mmg.com	(51) 01 418-4444
5	22	Trafigura Perú	1,418.10	Av Santo Toribio Nro 173 Piso 4 - San Isidro - Lima		(511) 4143300
6	23	Glencore	1,407.80	Edificio República, Pasaje Los Delfines 159, Urb. Las Gardenias, Santiago de Surco - Lima	info@glencore.com.pe	(511) 2177070 / (511) 2171100
7	28	Votarantim Metais-Cajamarquilla	1,107.00	Calle Central Nro. 9.5 Cajamarquilla (Carr.Central Km.9.5 Desvio a Huachipa) - Lima	-	(511) 3172200 / (511) 3172224
8	29	Shougang Hierro Perú	1,106.50	Av. República de Chile 262, Jesús María - Lima	comercial@shp.com.pe	(511) 7145214 / (511) 3307161
9	30	Hudbay minerals	1,092.40	Av. Jorge Chavez No. 235, Ofic. 701, Miraflores - Lima	-	(511) 6122900
10	37	Cía. Minera Antapaccay / ex Xstrata Tintaya	1,001.50	Edificio República, Pasaje Los Delfines 159, Urb. Las Gardenias, Santiago de Surco - Lima	info@glencore.com.pe	(511) 2177070 / (511) 2171100

[34] Available online: www.americaeconomia.com/negocios-industrias/este-es-el-ranking-de-las-500-mayores-empresas-de-peru-2021

11	55	Cía de Minas Buenaventura	675.50	Las Begonias 415, Piso 19, San Isidro - Lima	recursos@buenaventura.com.pe	(511) 419 500
12	56	Hochschild Mining	660.00	Calle La Colonia No. 180 Urb. El Vivero, Santiago de Surco - Lima	info@hocplc.com	(511) 3172000
13	60	Minera Yanacocha	642.20	Av. la Paz 1049, Miraflores - Lima	cyanacoc@Newmont.com	(511) 2152600
14	69	Nexa Resources	541.10	Av. Circunvalación del Club Golf Los Incas N° 170, Torre El Golf (Block A), Piso 22, Santiago de Surco - Lima	-	(511) 710 5500
15	70	Volcan Compañía Minera	535.50	Av. Manuel Olguin Nro. 375 Urb. Los Granados, Santiago de Surco - Lima	contact@volcan.com.pe	(511) 4631919

Source: AméricaEconomía Intelligence
Adapted by: CCSP

6.2. Suppliers[35]

According to the "Study of Mining Suppliers in Peru - 2021", carried out jointly by the Center for Competitiveness and Development and Linkminers, the mining sector works with 7,839 suppliers.

Of these suppliers, 64.9% have been in business for up to 20 years and 35.1% have been in the market for more than 20 years. Micro-sized suppliers make up 32% of the market, followed by large suppliers (31%), small suppliers (24%) and medium-sized suppliers (13%).

Suppliers are mainly of national capital (81%), and come mainly from the Micro and Small Enterprise category (51%). Foreign capital (12%) and mixed capital (6%) companies are mainly large, and only represent 11% of the total. 5% of foreign supply companies come from Switzerland[36].

It is important to note that in Peru:

- Purchases by mining companies from suppliers amount annually to $10 billion.
- 66% of the suppliers are located in Lima.
- 93% of companies state that innovation is part of their business strategy.
- 18% of management positions are held by women.
- The mining supplier sector amounts to 4.1% of GDP.
- Thirty percent of the suppliers export to the United States, Colombia, Bolivia, Ecuador, Chile, Brazil, and Argentina.

- Innovation is very important for 71% of the companies.
- 56% of supplier companies participate in collaborative projects, especially with mining companies.

Source: Study of Mining Suppliers in Peru – 2021, Linkminers

Internationally, there is strong competition among mining suppliers, mainly in: (1) mechanical machinery and apparatus products; (2) electrical machinery and equipment; (3) miscellaneous products of the chemical industries; (4) textile products, and (5) personal protective equipment. China and Germany are major exporters of machinery and equipment to the Peruvian mining industry.

Most of the supplying companies provide their equipment, goods and services during the construction of the mines, as complementary services, in open-pit mining, for crushing and grinding, for tailings, for mineral concentration and in underground mining. Micro- and small-size suppliers diversify their products and services quite well along the mining value chain.

[35] Available online: www.sammi.pe/noticias/primer-estudio-de-proveedores-mineros-del-peru-2021
[36] The average number of workers in the different sizes of companies is: Large enterprise (412), medium enterprise (28), small enterprise (20) and micro enterprise (5).

Figure 11. Participation of suppliers in the mining value chain

Percentages indicate the participation of suppliers in the different activities of the value chain.
Source: Study of Mining Suppliers in Peru, 2021
Adapted by: CCSP

Regarding Industry 4.0 technologies incorporated in supplier companies, the study highlights that remote monitoring is present in 43% of the companies, followed by automation (27%), data analytics (13%), intelligent sensing (8%), autonomous systems (4%), virtual and/or augmented reality (4%), 3D printing (4%), artificial intelligence/machine learning (3%), cybersecurity (2%), and robotics/dronautics (1%).

Source: Study of Mining Suppliers in Peru – 2021, Linkminers

Likewise, most suppliers innovate in products and services (82%), processes (44%) and business model (42%).

6.3. Regulators in the mining sector[37]

General Bureau of Environmental Health - DIGESA (www.digesa.minsa.gob.pe): this technical-regulatory body works in aspects related to basic sanitation, occupational health, hygienic food, zoonosis and environmental protection. It issues the regulations and assesses the environmental health processes in the sector. It is an entity under the Ministry of Health - MINSA.

General Bureau of Mining Environmental Matters - DGAAM (www.minem.gob.pe) this technical-regulatory body is responsible for proposing and assessing the Mining Sectors' environmental policy, proposing laws or issuing necessary rules. It also focuses on the promotion of environmental protection activities in mining activities.

General Mining Bureau - DGM (www.minem.gob.pe) is the MINEM Mining Line Unit responsible for ruling and promoting activities to secure the rational use of mining resources in harmony with the environment.

Geological, Mining and Metallurgical Institute - INGEMMET (www.ingemmet.gob.pe) is the public agency responsible for granting the titles to mining concessions, administrating the national mining register and processing, administrating and issuing geo-scientific information on the national territory in order to promote investment in Peru.

Hydric Resources Intendance of the National Institute of Natural Resources - INRENA's IRH (www.inrena.gob.pe) is the highest technical-regulatory authority responsible for promoting, overseeing and controlling the policies, plans, programs, projects and rules on sustainable use of hydric resources nationwide. It is part of the National Institute of Natural Resources (INRENA).

Mining Council (www.minem.gob.pe) is the highest-level administrative court of last resort over all mining matters that are subject to resolutions by the agencies under the Ministry of Energy and Mines (DGM, DGAAM, INGEMENT, and others).

Ministry of Agriculture - MINAG (www.minag.gob.pe) promotes the development of organized agrarian producers in the productive chains, in order to achieve a fully developed agriculture in terms of economic, social and environmental sustainability.

Ministry of Energy and Mines - MINEM (www.minem.gob.pe) is the central governing body for the Energy and Mining Sector and is part of the Executive Branch. Its purpose is to formulate and assess national policy in matters of sustainable development in the mining-power activities. It is the governing authority in environmental matters in reference to mining-energy activities.

Ministry of Labor and Employment Promotion - MTPE (www.mintra.gob.pe) is the body governing labor in Peru. It has all the powers required to lead the implementation of policies and programs for generating and improving employment. Is also responsible for enforcement of legislation for labor matters.

National Environmental Council - CONAM (www.conam.gob.pe) is the nation's environmental authority whose purpose is planning, promoting, coordinating, controlling and safeguarding the nation's environment and natural heritage. It sets the balance between socio-economic development, sustainable use of natural resources and preservation of the environment.

[37] Available online: www.ey.com/es_pe/mining-metals/mining-metals-investment-guide

National Superintendence of Tax Administration - SUNAT (www.sunat.gob.pe) is a decentralized public entity in the Economy and Finance Sector with economic, administrative, functional, financial and technical autonomy. It is the main tax-collecting agency in Peru.

Presidency of the Cabinet - PCM (www.pcm.gob.pe) is the technical-administrative body covered by the Executive Law; its highest authority is the President of the Cabinet. It coordinates and conducts follow-up on the Executive's multi-sector policies and programs, coordinates actions with the Congress and independent constitutional bodies, among others.

Supervisory Body of Private Investment in Energy and Mines - OSIGNERMIN (www.osignermin.gob.pe) is the regulatory, supervisory body that regulates, enforces and oversees the activities undertaken by public or private legal entities and individuals in the electricity, hydrocarbons and mining sub-sectors.

Technical Board of Irrigation District - ATDR (www.midagri.gob.pe) is the operational, functional and planning unit oriented towards the conservation and development of hydric resources. Its function is to administer water for agricultural and non-agricultural uses, in accordance with approved cultivation and irrigation plans.

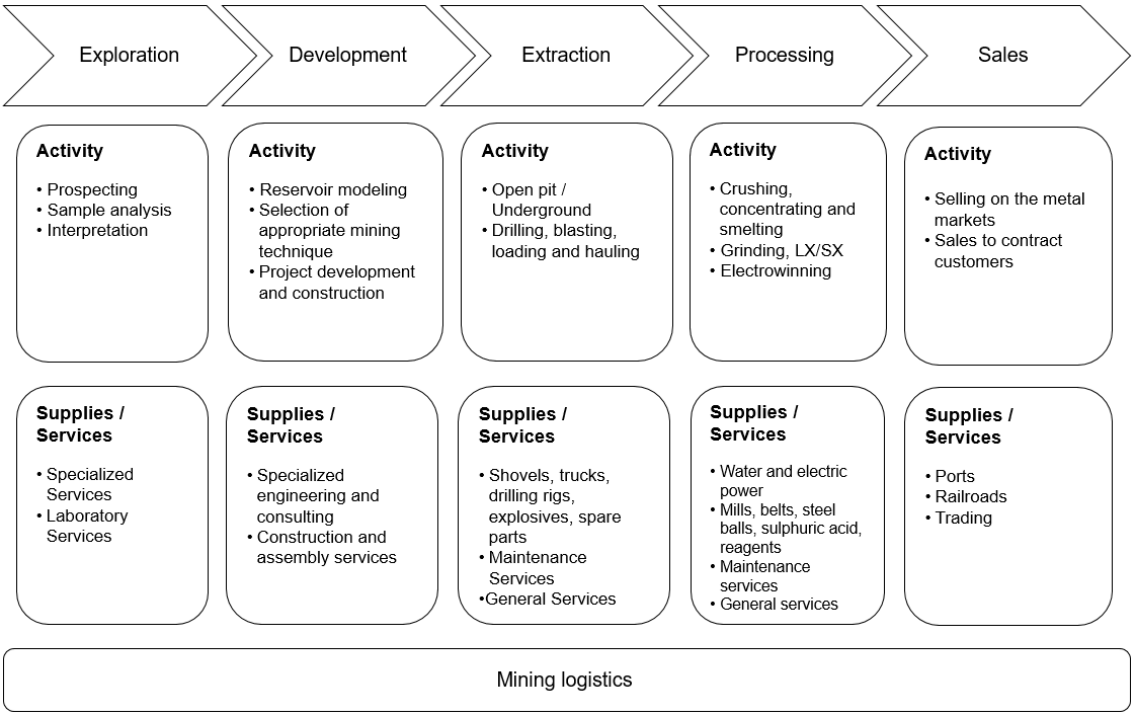
7. LOGISTICS AND DISTRIBUTION

Mining is a complex activity facing several logistics challenges. A close cooperation with the suppliers in the value chain is essential. The most critical logistics phase is the transport to the port for exports using public and private infrastructure. Suppliers must get familiar with mountainous conditions, adapt correspondingly their products and services and work closely with transport companies. Market entry can be undertaken under various forms.

7.1. Mining logistics infrastructure[38]

Logistics is one of the factors that contribute to the profitability of mining operations and plays a fundamental role in the efficient and timely supply of goods and services, ensuring the continuity and safety of operations. Thus, logistics activities must be integrated within the sector's value chain cooperating closely with machinery and systems suppliers, as shown in the following figure.

Figure 12. Mining sector value chain - Part 1[39]



Source: Las Cadenas Mineras Logísticas en el Perú, 2018
Adapted by: CCSP

Transport to the ports, which are the main export route and the final point of the resource value chain on a national scale, is considered the critical factor that hinders efficiency to the greatest extent in the mining sector.

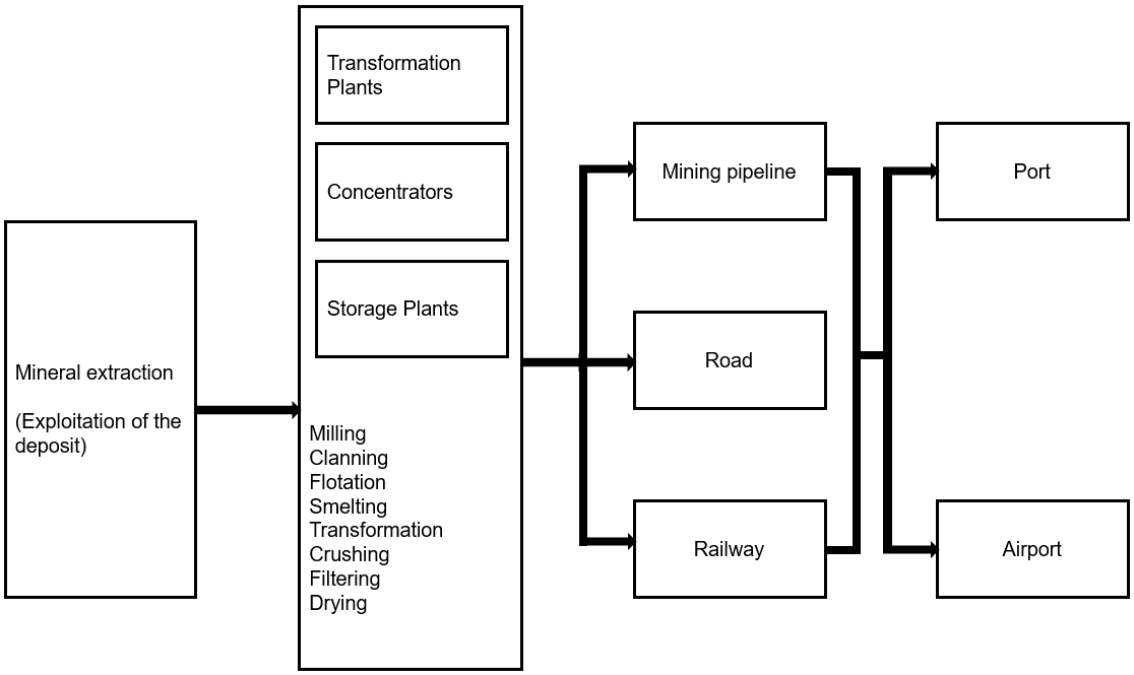
[38] Available online: https://repositorio.cepal.org/bitstream/handle/11362/43222/1/S1700874_es.pdf
[39] Available online: https://repositorio.cepal.org/bitstream/handle/11362/43222/1/S1700874_es.pdf

In Peru, the most widely used mode of inter-urban cargo transport is road (76%), followed by maritime and river cabotage (15%), rail (9%) and air (0.2%).

Source: Source: Las Cadenas Mineras Logísticas en el Perú, 2018

The transport and logistics system of the mining sector is mainly oriented to international markets since more than 95% of Peruvian mining production is exported. Therefore, the mining logistics chain uses a multimodal approach, articulated on ports, airports and roads/railways. As can be seen in the following figure, the mineral logistics chain begins with the exploitation and extraction stage of the deposit, moving on to the processing stage, from where the resources are transported by different means to the port (or airport, as the case may be) to be exported to foreign markets.

Figure 13. Mining sector value chain - Part 2[40]



Source: Las Cadenas Mineras Logísticas en el Perú, 2018
Adapted by: CCSP

The structure of the mining logistics chain is mainly geographic-territorial since the mine and the plants and/or concentrators are located close to where the deposit is mined. Thus, the infrastructure used by the mining sector is composed of public infrastructure (roads, railroads, ports) and private infrastructure (pipelines, ports, railroads) built by the mining companies for their specific use.

[40] Available online: https://repositorio.cepal.org/bitstream/handle/11362/43222/1/S1700874_es.pdf

7.2. Company structures for distribution

In order to distribute its products in Peru, an exporter has several options. He can seek a local distributor or establish one. The General Law of Companies[41] outlines the different types of companies and the requirements for their creation. The main aspects of these types are mentioned hereunder according to Ernst & Young[42]:

a. Joint Stock Companies

These companies require a minimum of two shareholders. The non-domiciled shareholders must designate an attorney in Peru to sign off on the bylaws. The funds must be deposited in a local bank and can be in local or foreign currency for the initial capital contribution (there is no minimum amount required but financial institutions generally require PEN 1,000 - approximately US$300). The capital stock is represented by shares, which are represented by certificates or book entries in return. The Trade Name must include “Sociedad Anónima” or the abbreviation “S.A.” and, Shareholders' liability is limited to the shares they hold and partners are not personally liable for the corporate debts.

b. Closely Held Corporations

These corporations resemble limited liability companies. They must have between two and twenty shareholders. Shares cannot be listed on the Public Stock Exchange Registry (RPMV) of the Peruvian Securities and Exchange Superintendency (SMV). The corporate name must include “Sociedad Anónima Cerrada” or the abbreviation S.A.C. Shareholders' liability is limited to the shares they hold, and partners are not personally liable for the corporate debts.

c. Publicly Held Corporations

Publicly held corporations are intended to be companies with a large number of shareholders (more than 750), for which debts can be converted into shares, an Initial Public Offering has been made, or more than 35% of the capital stock belongs to 175 or more shareholders. These shares must be listed on the Public Stock Exchange Registry (RPMV) of the Peruvian Securities and Exchange Superintendency (SMV). These corporations must include the indication “Sociedad Anónima Abierta” or the abbreviation S.A.A. Shareholders' liability is limited to the shares they hold. Partners are not personally liable for the corporate debts. These companies are subject to the supervision of the Peruvian Securities and Exchange Superintendency (SMV), and the transfer of shares is completely free (no restrictions or limitations are permitted).

d. Limited Liability Companies

These companies are established with a minimum of two and a maximum of twenty partners. This type of company will not issue shares. The incorporation procedures will be the same as those for the other corporations. Its capital is divided into ownership interests, which are accumulative and not divisible. Its name must include "Sociedad Comercial de Responsabilidad Limitada" or the abbreviation "S.R.L." and partners are not personally liable for the corporate obligations.

e. Branches

[41] Available on line: https://diariooficial.elperuano.pe/pdf/0004/2-ley-general-de-sociedades-1.pdf
[42] Available on line: www.ey.com/es_pe/entrepreneurship/peru-business-investment-guide

Branches, either national or foreign, carry out activities in different location than its principal place of business. They do not have their own separate legal standing. The parent company is liable for the branch's obligations. For branches established by foreign corporations, the agreement for the establishment of a branch by the parent company need to be notarized by the Peruvian consulate and certified by the Ministry of Foreign Affairs (MRE) in Peru, or be apostilled in its country of origin for it to be put into the form of a notarially recorded instrument and registered in the Public Records Office. Brand registration requires, among other things, a certificate of good standing of the parent company, duly notarized or apostilled, as applicable. According to the General Law of Companies, branches of foreign companies may be transformed so as to be incorporated in Peru under any corporation type regulated by the General Law of Companies.

8. CASE STUDIES

Testimonials from important firms -Sika, Geobrugg, ABB, Linkminers and the Mining Innovation Hub- illustrate important points of the report. Swiss products are well known worldwide for their quality, reliability and high performance. Efficiency solutions is on the top of the agenda with industry 4.0 and to transform traditional mining processes. Local presence facilitates significantly market penetration.

History

Sika[43] is a leading company worldwide in products for construction and industry (Automotive aftermarket, transport, automotive, household appliances, marine, building components, renewable energies, textiles and fuels). It was founded in Switzerland in 1910 and has been in Peru since 1997, where it has more than 170 employees.

Participation in the mining supply chain

As part of the mineral supply chain, Sika provides products in the extraction process.

Sika supplies the mining sector with additives, accelerators and fibers for the production of shotcrete, a material used for the support inside the pit. Sika also has an injection system that allows the consolidation of the rock mass or the deposit of soils in open pit mines as well as in mines with undercuts. For the tailings backfilling process, Sika has an additive line that allows the use of this material combined with cement to obtain a fluid concrete called Pastefill, ensuring that this backfill is sufficiently fluid and cohesive to be pumped and placed inside the mine. Recently, through its Aliva brand, Sika has developed an all-electric casting robot called Aliva 520.

> Regarding the environment, the use of Sika's additives reduces water consumption and minimizes the pressure in the launching equipment, guaranteeing the reduction of CO_2 emissions within the mining operations.
>
> Sika has a bulk system that reduces additive waste, as well as the use of plastic containers and the use of water for their possible washing.
>
> Interview with Sika, Lima, March 2022

[43] Available online: https://per.sika.com

In addition, its injection system consolidates the advance of the pit, optimizing the use of explosives and reducing the risk of collapse. Finally, its all-electric Aliva 520 product emits no CO_2 throughout the operation.

In terms of responsible value chain, Sika contributes with environmentally-friendly product design and production methods. Its Viscocrete line of high-range water-reducing admixtures can reduce water use in concrete production by up to 40%. In addition, its Stabilizer line allows the use of the highest possible tailings content for pastefill production, and Aliva 520 does not emit CO_2 during operation.

Digital technologies

Sika used digital tools at trade fairs. For example, at the fair "Yo Constructor 2022", attendees are educated through QR's codes on Sika's new technological solutions in its target markets such as waterproofing of concrete structures, concrete admixtures, waterproofing for roofing, floor coverings, protection, repair and rehabilitation of structures, adhesives and setting for ceramic and porcelain tiles, sealing and gluing and industry.

Covid-19 APP is an application used by Sika to determine if a person has covid-19 symptoms, which allows to prevent contagion within the plant. Sika also provides training for workers to promote cybersecurity, such as detecting possible phishing[44] fraud and has antivirus and encrypted information for all personnel.

Sustainable development

In Peru, Sika contributes to sustainable local development.

Sika generates value and maintains a positive relationship with communities. Sika defines the scope of its interventions and indicators so that all Sika offices around the world work aligned to the same objectives and to building trust.

Community Engagement is part of Sika's sustainability strategy "More Value, Less Impact" and has three main indicators:

- 10,000 working days of volunteering per year among all 100+ Sika locations worldwide.
- 50% more projects each year.
- 50% more direct beneficiaries each year.

In relation to the responsible use of resources, specifically in the area of energy, Sika is working to:

- Reduce at least 3% of energy per ton sold per year.
- Increase clean energy to achieve a 50% share by 2023.

44 Phishing is a type of informatics attack which used to steal users' data such as login credentials and credit card numbers.

On water consumption and waste generation, Sika has the following objectives:

- 3% less waste generation per ton sold per year.
- 25% more recycling of total waste.
- 3% less water consumption per ton sold per year.

In its facilities in Peru Sika also has a hydroponic garden, a form of gardening that uses no soil but instead grows plants in a solution of water and nutrients; a hydroponic system can grow plants and vegetables faster than growing outdoors in soil, and hydroponic systems can be used year-round.

All these objectives are achieved in the different areas of the firm, fulfilling the mandate of having sustainability present in all actions. This is closely monitored with the quarterly Global Reporting Initiative (GRI)[45] at local and corporate level.

[45] The Global Reporting Initiative (known as GRI) is an international independent standards organization that helps businesses, governments and other organizations understand and communicate their impacts on issues such as climate change, human rights and corruption. Source: Global Reporting Initiative - Wikipedia

Geobrugg[46] is a Swiss company based in Romanshorn, which creates solutions providing protection against natural hazards since 1951. They include high-tensile steel wire nets and matching services to monitor risks protecting against rockfall, landslides, debris flows, avalanches or coastal erosion. Geobrugg seeks to ensure safety in mining and tunneling as well as on motor sports tracks, in industry and in test facilities. Its production and a presence in over 50 countries are highly valued by consumers in terms of proximity and quick project implementation from requirements analysis to execution.

Geobrugg has been represented in Peru in the past few years through a distributor company and has opened a branch office in 2021.

Geobrugg fields of application

- **Rockfall protection:** rockfall protection barriers stop impacts with energies up to 10'000 kJ - kilojules (world record).
- **Slope stabilization:** nets anchored to the ground with soil nails and spike plates securing the slope. The mesh is almost invisible which favors revegetation.
- **Protection against landslides and debris flows:** Geobrugg's systems provide particularly efficient and sustainable protection against these natural hazards.
- **Avalanche prevention:** flexible protection system reliably holds back snow masses and, in the snow-free period, provides effective rockfall protection.
- **Mining / tunnels:** meshes and mechanical installation aids are a safety and efficiency factor in mining as well as in tunnels worldwide (people, machines and infrastructure are protected even in critical zones). This reduces work interruptions.
- **Monitoring and alarm systems:** they increase safety based on digital processes, enable predictive maintenance, and thus reduce costs.
- **Special solutions:** in the area of impact protection, Geobrugg systems stop flying / falling debris or accelerated objects of all kinds.

Mr. Romero, General Manager Peru, has shared the following information with the Swiss Chamber of Commerce in Peru:

Geobrugg, as any company related to the mining sector, knows that mining plays a significant role to promote socio-economic development in communities by contributing to formalize labor, among others.

Peru and Chile have the most important mining sector at the South American level. Mining represents a considerable percentage of Peru's economic activity and contributes to the development of the country.

[46] Available online: www.geobrugg.com/en/Geobrugg-Safety-is-our-nature-114435.html

Geobrugg's is characterized by high technology, innovation and manufacturing of protection and stabilization systems for geological or natural hazards, such as: dynamic barriers against rock falls, slope stabilization systems using high strength steel mesh, flexible barriers against debris flows or landslides and superficial soil slides, attenuator systems, drape or curtain mesh, deflectors and shock absorbers against rock or block falls, high strength steel mesh for subway fortification and mechanized installation of MESHA® device, online tool software for dimensioning of protection and stabilization systems against geological risks.

Geobrugg mainly works with companies in the field or geotechnical firms such as Noematériales, CGES Perú, Aceros Arequipa and DSI Underground. Installation of its systems is mainly undertaken by Desnivel Perú SAC and some other contractors.

Considering the importance and size of the mining sector in Peru, business opportunities for Geobrugg products and protection systems are high, as in other sectors that may be affected by geological risks. an all-electric casting robot called Aliva 520.

> One of the key challenges is to provide comprehensive support with Geobrugg's systems, thus increasing the level of security regarding the protection of human lives, facilities and other infrastructures, allowing thereby daily activities in a normal, planned and uninterrupted way.
>
> Interview with Geobrugg, Lima, March 2022

Geobrugg projects in Peru

2016: Dynamic Barrier in Quebrada Carosio: Length of 60 m, 6 m. high and 6 intermediate posts. Second longest barrier in the world and longest in South America.



2017: During the rainy season the sweepers were filled and worked perfectly.



Table 6. Other projects by Geobrugg

Project name	Location	Type of solution	Length	Drilling
Key yard protection CH Cheves (2020)	Churin - Perú	Flexible barrier LandSlide SL-150 (E=150 kN/m²; H=3.5m)	-	-
Protection of Coricancha mining unit facilities	Lima - Peru	Dynamic barrier GBE-3000A (E=3000kJ; H=6.0m)	100 m.	288 m.
Lagoon protection system reserves - Conga Project	Cajamarca - Peru	Dynamic barrier GBE-100A-R (E=100kJ; H=2.0m)	600 m (in 5 sections)	290 m.
Dynamic impact barrier at the San Mateo water plant	San Mateo - Lima - Peru	Dynamic barrier GBE-500A (E=500kJ; H=4.0m)	60 m.	136 m.
Protection of the loading chamber at C.H.CELEPSA	Yauyos - Lima - Peru	Dynamic barrier GBE-500A (E=500kJ; H=5.0m)	80 m.	90 m.
Rockfall barrier at Cerro del Aguila H.C.H.	Huancavelica - Peru	GBE 2000AH5 Barrier	120 m.	-
Antamina Primary Crusher Protection (2003)	Ancash - Peru	Dynamic barrier RX-150 (E=1500kJ; H=5.0m)	60 m.	108 m.
Pipe and pump protection	Ancash - Peru	Dynamic barrier	-	-
Protection of housing Cerro Huaripampa, San Marcos City	Ancash - Peru	Dynamic barrier RXI-200 (E=2000kJ; H=4.0m)	150 m. (2 sections of 80 and 70 m.)	244 m.
Risk mitigation (2017/18)	Oyón Province - Peru	Minax80/3	-	-

The Swiss company ABB S.A.[47] is a leader in energy and automation technologies for industrial processes, power generation and transmission that established operations in Peru in 1952 and currently employs 280 people in the country.

The company is engaged in the wholesale and retail marketing of machines, equipment and electrical appliances, distributed in the mining, oil, gas and petrochemical industries, process industries, food & beverage, water & waste, infrastructure and construction, smart cities, smart power distribution, digital solutions, energy management, asset management, building management, electric vehicles infrastructure and others. In Peru it has a production plant located in Lima, and occupies an area of 20,000 sqm. It has workshops in Lima and Arequipa for ABB Portfolio Services.

Company representatives have shared the following information with the Swiss Chamber of Commerce in Peru.

> In mining, ABB supplies machinery, products and services used for extraction; it has also solutions for ore refining and energy efficiency, among others.
>
> Interview with ABB, Lima, April 2022

Safe work environment

ABB adopts specific measures to provide a safe environment at work to limit workplace accidents and employee injuries. Operational control measures are based on the hierarchy of controls: elimination, substitution, engineering controls and administrative controls. ABB has a safety, health and environmental management system implemented under internal global standards and international regulations. It has ISO 14001:2015 and ISO 45001:2018 certifications.

Reducing greenhouse gas emissions in its operations

ABB seeks to reduce energy and fuel consumption and has set globally its sustainability goals for the year 2030. ABB aims at achieving a low-carbon society, carbon neutrality in operations and at supporting its customers in reducing annual CO2 emissions by >100 Mt1.

[47] Information available online: https://new.abb.com/south-america

Non-recyclable waste and substances that deplete the ozone layer

ABB seeks new alternatives to reduce non-recyclable waste through composting or incineration techniques with energy recovery. It has set the following sustainability global goals for the year 2030: preserve resources, 80% of ABB products and solutions covered under the circular economy approach, zero waste to landfill, and sustainability framework for suppliers.

ABB also minimizes the use of substances that deplete the ozone layer. ABB Peru uses SF6 gas for some of its solutions under controlled handling in minimum quantities, to avoid accidental emissions. Presently, ABB is considering the use of solar energy at its Arequipa plant.

> ABB adopts specific measures to increase the share of eco-efficiency with products and solutions that help to increase the energy efficiency of mining processes, as well as to replace and reduce the consumption of fossil fuels. In addition, ABB has high efficiency motors, variable speed drives and solutions for electro mobility inside the mine, control systems, solutions and products in low and medium voltage and digital services (ABB Ability).
>
> Interview with ABB, Lima, April 2022

High sustainability criteria for suppliers

- Procurement sustainability roadmap: ABB has a supplier approval process in categories such as safety, integrity, supply chain and sustainability. This ensures compliance with customer requirements in the short, medium and long term. Subsequently, for suppliers with significant purchases and in critical categories, they are asked to participate in global programs such as Sustainable Supply Base Management and conflict minerals regulation, in which they are trained, audited and work on plans regarding: labor practices, social benefits, safety, environment, subcontracting, equal opportunities, equity security, competence and training, among others.

- Supplier sustainability assessments: in accordance with its global and local procedures, quality-critical suppliers are evaluated annually in different categories such as quality, delivery and safety that are part of sustainability criteria. Likewise, critical suppliers and those with larger purchase amounts are invited to participate in the sustainability programs detailed in the preceding paragraph.

- Suppliers sign a code of business partners: all business partners at the time of approval sign the supplier code of conduct in which they commit to do business in an ethical, safe and sustainable manner, respect labor regulations based on fair working conditions, generating confidence to all stakeholders, to protect the assets and reputation of the company.

- Integration of sustainability criteria into procurement strategies: its homologation process allows to have a database of suppliers that meet sustainability standards and then this database is used in the procurement process of the requirements.

- Traceability system for gold and precious metals: ABB is determined to comply with legal and customer requirements regarding the prohibition and restriction of substances, including hazardous substances and conflict minerals. Therefore, suppliers shall ensure that goods supplied to ABB comply with the requirements set forth under the scope of all applicable regulations.

Continuous improvement of the sustainability of suppliers' products

- Special emphasis on sustainable solutions: ABB products are world leaders in the electrification, motors, drives, automation and robotics businesses, which have a high technological component based on research and development, allowing to work in a safe, smart and sustainable way. ABB scientists and engineers are constantly innovating products, systems and services that increase energy efficiency, reliability and productivity for the industries where they operate; they also have collaboration agreements with universities globally which are incubators of future technology.

- Safety and environmental aspects: during the homologation process it is verified that the products and services purchased from our suppliers come from and are made in compliance with national and international standards such as NENA, ANSI, IEC, etc. Additionally, the terms of reference for the procurement process include technical requirements in terms of safety and environment.

- Getting more value with less impact: while ABB is on track to achieve carbon neutrality by 2030, its biggest contribution to sustainable development is through its offerings to customers. By 2030, its goal is to help its customers to reduce their annual GHG emissions by at least 100 megatons, equal to the annual emissions of 30 million combustion cars. In 2021, ABB identified a basket of products, services and solutions from its portfolio offering substantial reductions in customers' GHG emissions.

Sustainability of the logistics chain

- Systematically measure and analyze key transportation and environmental figures with logistics providers: ABB works with global logistics operators with high standards of operation and who seek sustainable and efficient practices just like ABB. Together with their logistics partners, they have data analytics systems and tools that allow them to keep track of logistics operations globally in search of efficiencies.

- Improve logistics with suppliers and customers: ABB works closely with suppliers to ensure its sustainability expectations. As its suppliers are an extension of ABB, they are an integral part of its sustainable growth. To clarify their expectations, they publish the ABB Supplier Code of Conduct (SCoC). This document reflects the 10 principles of the UN Global Compact and the essence of the ABB Code of Conduct.

ABB considers that the main opportunities are based on products and solutions that help companies to digitize their processes and reduce their ecological footprint.

ABB recommends companies to invest thinking in the medium term, be very close to their customers and rely on local personnel for the development of their operations.

Interview with ABB, Lima, April 2022

Linkminers[48] is a Peruvian company founded in 2018 looking for solutions for challenges and requirements in the mining industry.

Mr. Gómez de la Torre, CEO, and Mr. Valdivia, Operations Manager, shared information with the Swiss Chamber of Commerce in Peru.

Mining companies can access Linkminers' information services on an electronic platform. Linkminers reviews solutions based on operational needs and also facilitates establishing links with suppliers.

Linkminers' digital platform has more than 50 mining companies and more than a thousand solutions coming from companies in more than 30 countries. All the solutions are available to the industry.

Linkminers is expanding the company in Latin America (managers from mining companies in Peru, Ecuador, Mexico and Chile actively use the platform) and seek to scale globally. To this end, Linkminers has set up alliances with various national and international entities that promote commercial exchange between countries.

Linkminers also publishes several annual reports on the sector, in conjunction with other entities, such as the "Peru Mining Suppliers Study 2021", which was used for this Report.

Most of the solutions sought by companies in the sector are aimed at efficiency problems, and this has become a trend. Figures 14 and 15 highlight some important facts:

- In large-scale mining, 78% of the firms address mining efficiency as a key need, 75% in medium-scale mining and 86% in small-scale mining.
- In large-scale mining, 69% of the firms address digital issues as a key need, 44% in medium-scale mining and 57% in small-scale mining.
- Sustainability is becoming increasingly important for large-scale mining with 11% of the firms, 17% of the firms in medium-scale mining and 29% of the firms in small-scale mining.
- 42% of large mining companies refer both to efficiency and digital issues, 19% of fims in medium-scale mining and 29% of firms in small-scale mining.
- Referring to operational requirements, 20% of the firms refer to hauling, loading and transfer of materials, followed by leaching, concentrator and smelting plant

[48] Information available online: www.linkminers.com

(17%), SSOMA (Occupational Health and Safety and Environment) process (15%) and crushing and grinding (10%).
- Monitoring and connection of mining operation technologies also raise important challenges.

Industry 4.0 represents a great opportunity for digital solutions. Large mining companies are very interested because they already have a technological level that enables them to introduce new solutions to improve efficiency.

Solutions for more classic processes such as energy, tools and spare parts for critical operations or for auxiliary equipment are equally necessary and regularly sought by mining companies, regardless of their size.

Switzerland has a very large technological offer for the mining sector both in large world-class companies and in smaller companies focusing on niches and very specific solutions.

It is important for suppliers to show that their products, services and systems include digitalization or favor decarbonization, because they reflect a big trend.

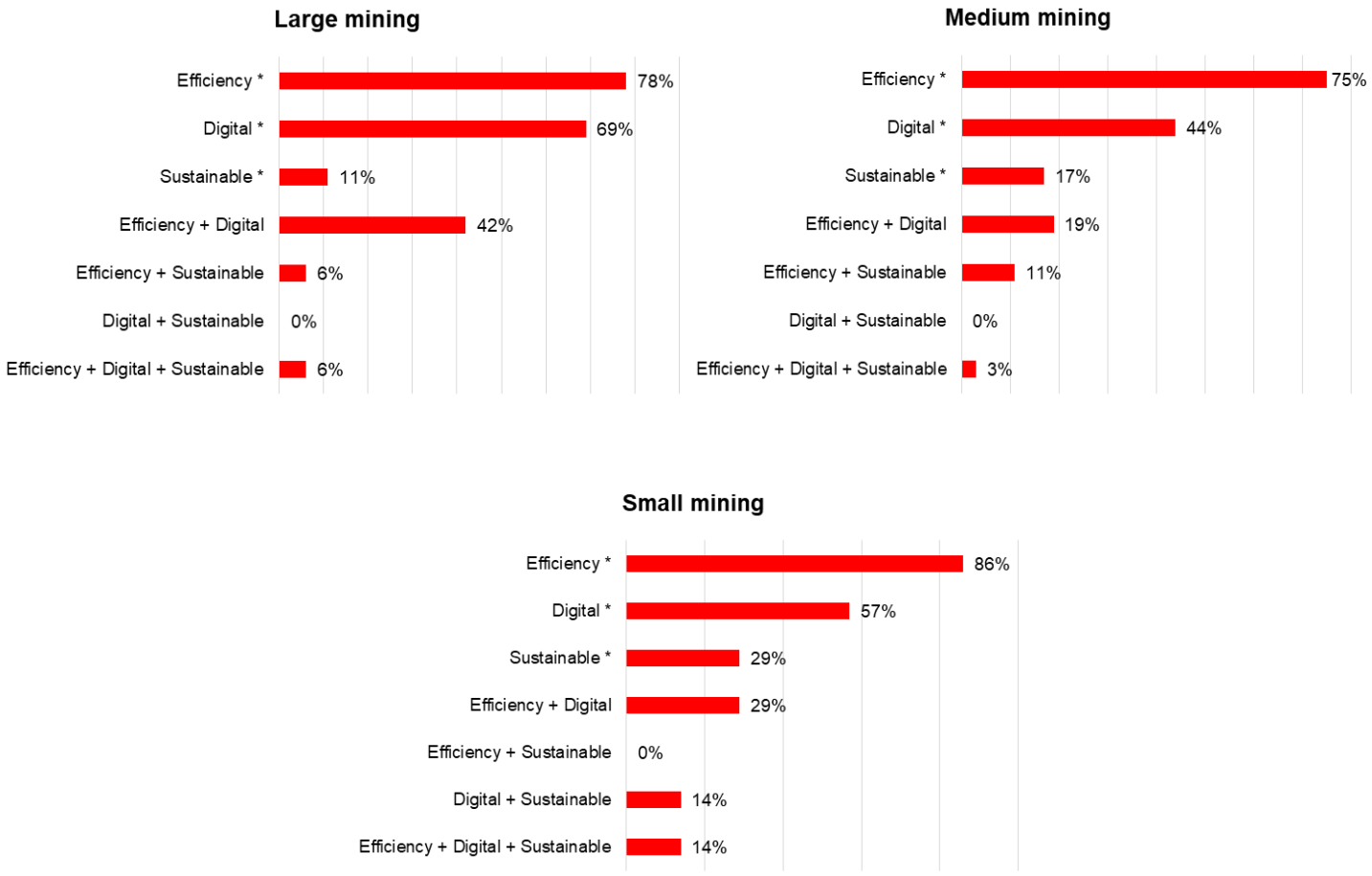
Peruvian mining is very active in the search for solutions to cross-cutting challenges and if there are proposals that have already been tested in other parts of the world and are innovative, they will be in great demand.

> Experience with mining companies shows that it is extremely important for suppliers to have a local presence.
>
> The technology, service and practical know-how may be in Switzerland but the operations are in very remote locations where response times are key.
>
> Having a local partner or representative makes all the difference between winning a contract and not winning it when technical proposals and prices are very similar.
>
> Interview with Linkminers, Lima, March 2022

Since mining is a high-risk activity, where an innovation can generate incidents, loss of production and significant costs, mining companies always need to know where it has been used before to gain sufficient confidence even if they may believe that a new solution may be very good.

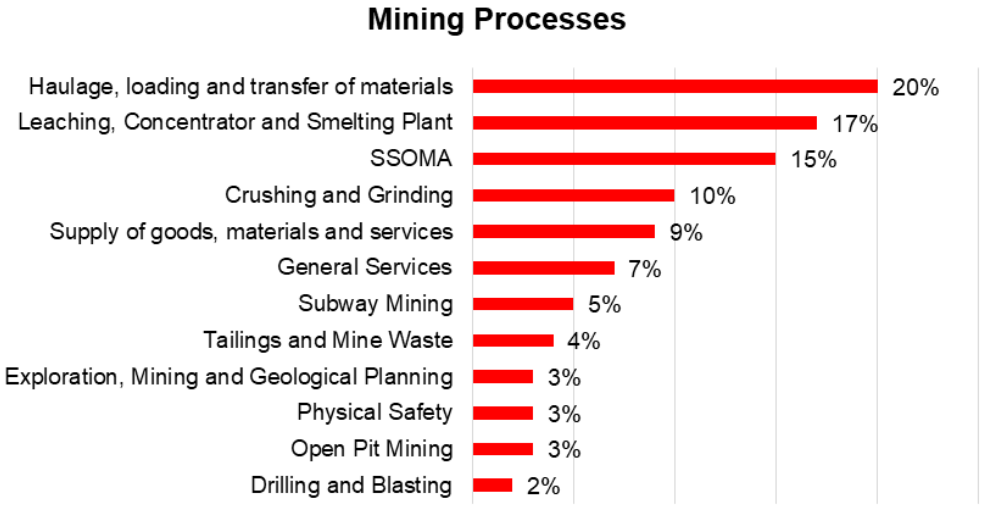
According to Linkminers, the Peruvian market is very attractive, regardless of the global and political situation in Latin America, because of its polymetallic wealth, diverse sizes and open-pit and subway mines, which generate opportunities.

Figure 14. Operational needs by mine size



Source: Linkminers
Adapted by: CCSP

Figure 15. Operational requirements by mining process



Source: Linkminers
Adapted by: CCSP

The Mining Innovation Hub[49] is an associative program established by mining companies to facilitate innovation and collaboration in the sector. It does not have a commercial focus but functions as a club where the companies hold meetings to seek solutions to problems that arise and to discuss topics of interest.

The Hub has the following objectives:

- Promote the culture of innovation and collaboration.
- Reduce efforts to connect with the ecosystem.
- Accelerate the development of initiatives aiming at solving challenges.
- Position mining as an innovative sector.

The Hub seeks to facilitate innovation through three main lines of action:

1. **Spaces for sharing.** Mining is a sector where innovation takes place inside and outside the mine, but also with peers. This sector has a lot of potential for sharing and companies are very interested in knowing what their peers are doing so as not to develop something that already exists and works.

2. **Bringing outside innovation closer to mining companies.** This objective is met by carrying out open innovation, inviting innovative companies and always seeking to know what new companies are doing. Specific calls are made in response to inquiries from partner companies and if there are no solutions available, calls for open innovation are launched. All information is shared with partner companies so that everyone can benefit.

3. **People.** The Hub organizes activities to promote a culture of innovation and holds training workshops to increase the interest of the sector to new technologies.

According to Mrs. Antonioli, CEO, and Mrs. Torres, Senior Project Executive, opportunities depend on an innovation providing an effective solution to a problem in the sector. The Hub validates innovative proposals with several companies at the same time in an environment of trust.

The Hub also works with start-ups and Universities' projects and seek funding for the development of technologies. The Hub looks for concrete solutions that can be feasibly implemented in the sector.

[49] Available online: https://hubinnovacionminera.pe/

Opportunities and recommendations for Swiss companies

The mining sector is still quite traditional and mining companies always ask if solutions addressing specific issues have already been tested in similar projects in order to gain trust. They consider it very important to show concrete evidence on the characteristics and effects of innovations.

Technology is often perceived as very complex. It is important to keep in mind that mining companies in Peru look for technologies simplifying processes, easily adoptable, and with a training plan.

Compatibility of new systems with existing ones is essential. Mining companies are digitally transforming themselves to integrate data in all their operations, especially with 4.0 technology. In this context, it must be emphasized that mining takes place in remote areas and connectivity is very important.

> The pandemic has highlighted that a local partner may be very helpful in mining. For instance, it may facilitate market entry with match-making platforms to validate new processes and products or to undertake pilot tests. It is always better to have someone available locally.
>
> Interview with the Mining Innovation Hub, Lima, March 2022

Local partners hold meetings to test new proposals providing solutions to specific problems with interested companies or to present success stories.

Suppliers with a comprehensive Environmental, Social and Corporate Governance strategy are well considered because mining companies are increasingly seeking such certifications for their operational processes.

9. CONCLUSIONS / CALL-FOR-ACTION

1. Several Swiss firms are active in the mining value chain in Peru and in Latin America; they have a significant potential in innovative cleantech products and solutions to strengthen the sustainability of mining economies.

2. The technologies required to increase efficiency and productivity, and to modernize equipment in the operation and maintenance fronts rank first in terms of business opportunities (197), followed by smart mining (29), sustainable mining (22) and finally other fields (19).

3. Peruvian mining companies primarily require products that secure key operations, regardless of whether they are cleantech intensive; however, there is a positive trend to purchase more products that ensure environmental sustainability.

4. Peru's needs in mining value chain will grow exponentially over the coming years due to very large planned investments and the growth in world demand for minerals, mainly for copper.

5. Despite a difficult administrative environment and political instability, Peru should continue to belong to the leading Latin American countries in terms of economic growth, driven by the mining sector.

6. Suppliers are subject to local and external risks which may strongly affect the mining activity.

7. Swiss SMEs are well positioned with a good reputation for reliable, high-performance, and high-quality products and services.

8. The Swiss Better Gold Initiative is an outstanding example of Swissness contributing to the formalization of small- and medium-scale mines and providing miners higher revenues.

9. One of the most important challenge for doing business within the Peruvian mining value chain is to become a regular supplier of a major mine.

10. The optimal business strategy to enter the mining value chain is to establish a branch or a distributor in Peru and to work with a strong and reliable local company to deal with legal, fiscal, labor, environmental and overall business issues.

Call-for-action

The Swiss Chamber of Commerce in Peru, with 69 years of professional experience and with 150 partners in different business sectors, is an excellent ally in entering the Peruvian market.

With the elaboration of this report, the Chamber of Commerce has developed an exclusive expertise in the Mining field for the benefit of Swiss companies.

Swiss firms have a strong reputation and a lot to offer. They should rapidly increase their presence or establish it in Peru, a market for the future!

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10. ANNEXES

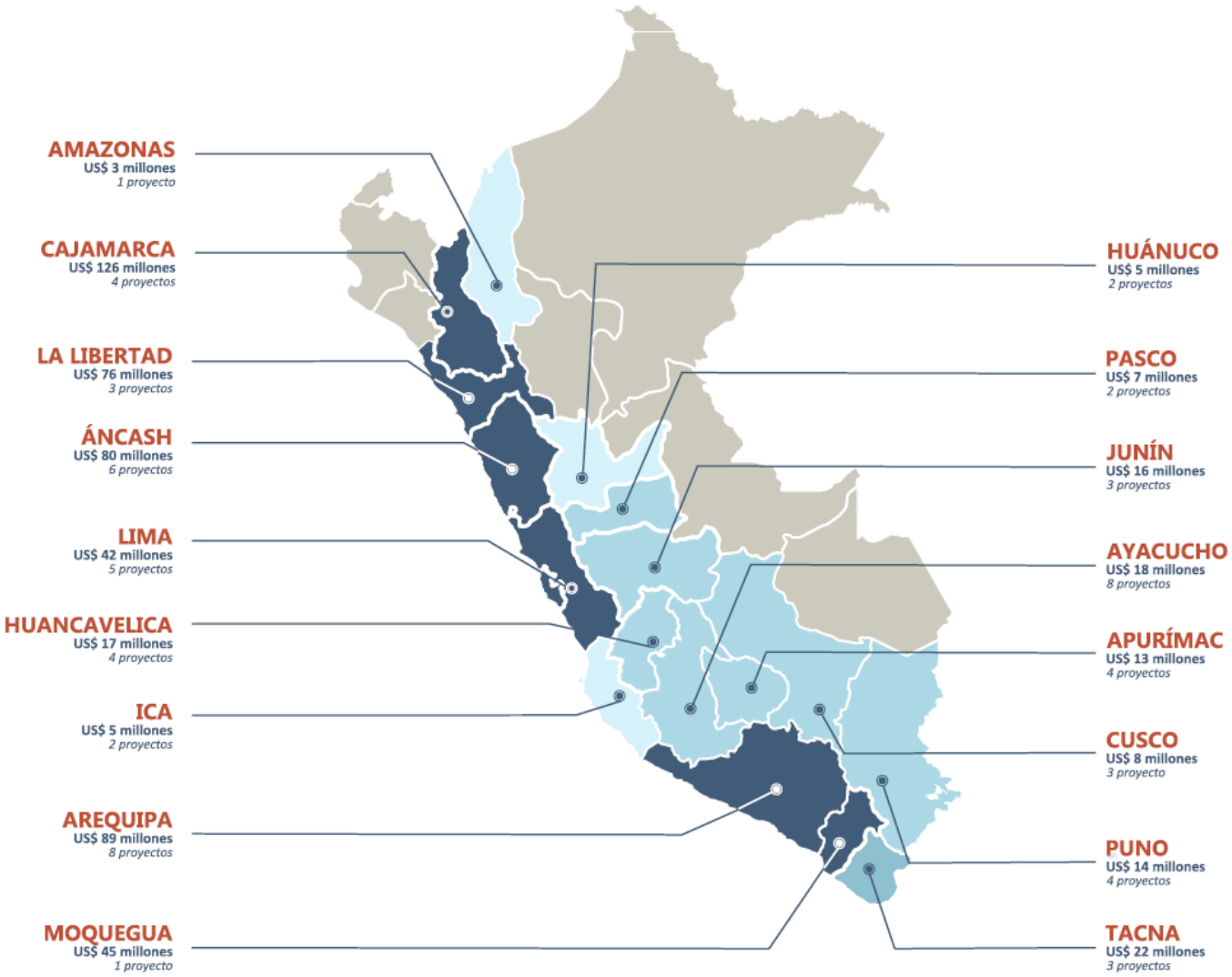
Annex 1. Illegal Mining and Informal Mining

Illegal mining	Informal mining
Mining activity carried out by a natural or legal person or group of persons organized to carry out such activity, using equipment and machinery that does not correspond to the characteristics of the mining activity being carried out (Small Mining Producer or Artisanal Mining Producer) or without complying with the requirements of the administrative, technical, social, and environmental regulations governing such activities, or that is carried out in areas where such activity is prohibited. Notwithstanding the foregoing, any mining activity carried out in areas where the exercise of mining activity is prohibited is considered illegal.	Mining activity that is carried out using equipment and machinery that does not correspond to the characteristics of the mining activity being developed (Small Mining Producer or Artisanal Mining Producer) or without complying with the requirements of the administrative, technical, social and environmental regulations governing such activities, in areas not prohibited for mining activity and by a person, natural or legal, or group of persons organized to carry out such activity who have initiated a formalization process.
Differences[50]	
- Illegal mining is that which works in areas not permitted by law, works in bodies of water, uses machinery prohibited for small-scale and artisanal mining, does not have a Declaration of Commitment and is therefore subject to interdiction. - Illegal miners cannot be formalized.	- Informal miners are those who do not work under any of the aforementioned conditions, and who have also joined the formalization process promoted by the State. - If the company complies with the established requirements, it can become formal.

Source: Legislative Decree Nº 1105 & Ministry of Environment, 2016

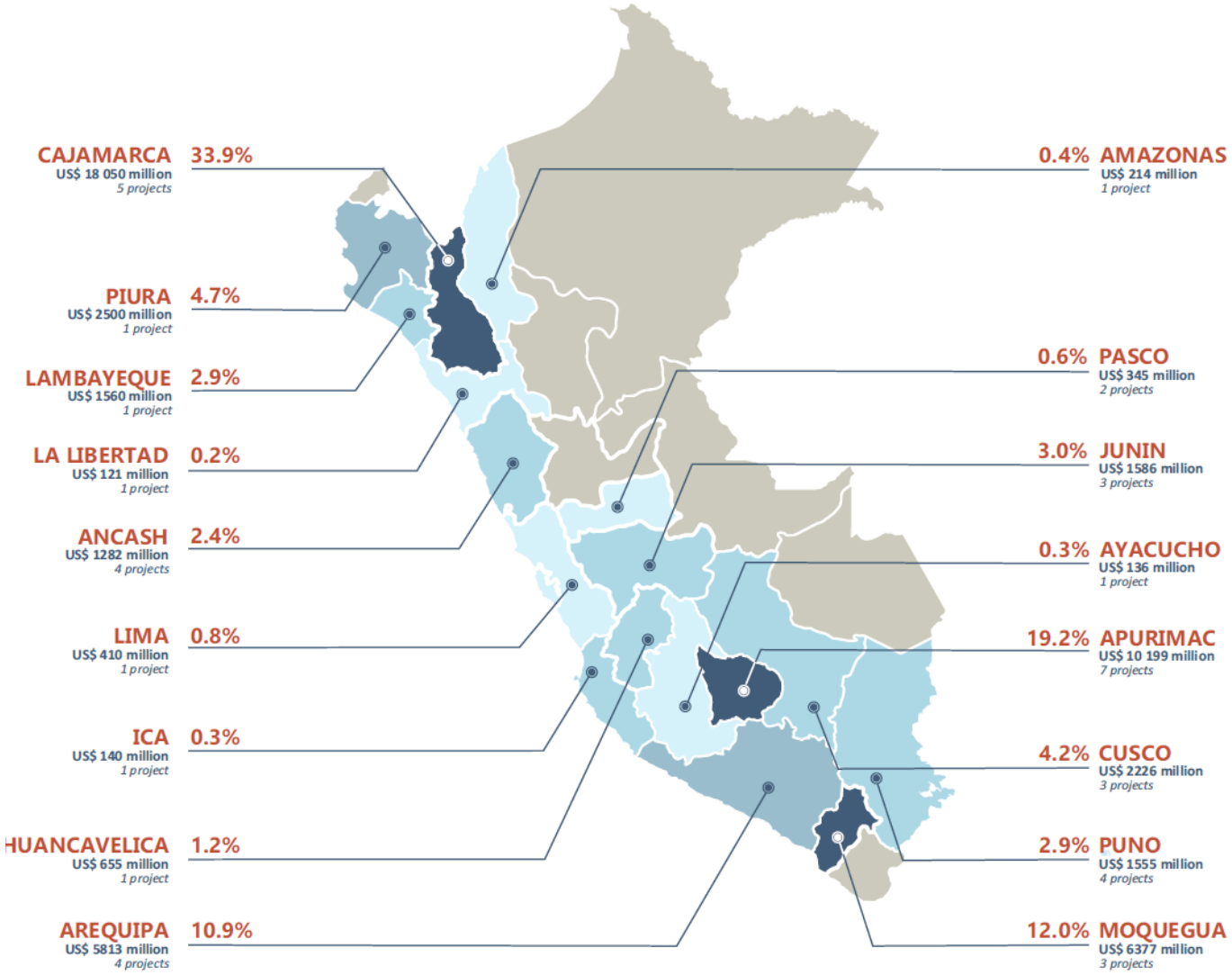
[50] Ministry of Environment. (2016). Sectoral report of the environment "The struggle for legality in the mining activity 2011-2016".

Annex 2. Investment in mine exploration projects by location, 2022



Source: Ministry of Energy and Mines, 2022 Mining exploration project portfolio.
Available online: www.minem.gob.pe/_publicacion.php?idSector=1&idPublicacion=646

Annex 3. Investment in mine construction projects by location, 2021



Source: Ministry of Energy and Mines, 2021. Portfolio of mining construction projects. Available online: www.minem.gob.pe/_publicacion.php?idSector=1&idPublicacion=642

Annex 4. Mining needs - Core Processes category; subcategory Hauling, loading and transfer of materials, 2020-2022

2022	• Vibration in truck 793D (out of permissible limits) • Consulting services to verify the stockpile management plan. • Soil stabilization and construction of accesses with saturated materials. • Efficient segregation of construction clays • Controlled demolition of reinforced concrete walls of great thickness. • Solution for haulage road maintenance in mining operations • LED signage for haulage roads • Soil stabilization and access construction with saturated materials • Improving the productivity of fine and coarse sand placement in construction
2021	• Anti-rock fall system • Achieve reduction of fuel and CO2 emissions. • Presence of Carryback in mining dump truck hoppers • Dust emission reduction on unpaved roads • “Inchancables” detection system (materials that cannot be demolished) • Reduction of fuel consumption in the KOM 930E haulage fleet. • Transport of coal from harvesting room to reactor • Transport of tailings for reprocessing • Reducing dust generation on haul truck roads • Outsourcing: Ore selectivity at the loading stage (sensors on shovels) • Migration from pneumatic to hydraulic Winche Fullerton braking system • Simulation of mining operations - Loading and haulage processes. • Implementation of loT system to determine driving profiles. • Fatigue and drowsiness detection in concentrate transport drivers. • Predictive detection of boloneria (fragmentation) in haul trucks. • Cleaning of smelting cups • Implementation of guard change modules • Integration of free valve engines to haul trucks • Reducing fuel consumption in haul trucks • Increasing traction on OTR tires • Measurement of variable temperature and vibration of the conveyor belt idlers • Reducing the weight of 3/4 thick T21 plates by other anti-abrasive material • Dual LNG-Diesel systems for haulage equipment (between 0-4000 masl). • technologies to mitigate vehicle interaction incidents • Monitoring of vital signs and measurement of operator sleep quality KPIs • Detection and monitoring of GETS drop-offs
2020	• Reducing fuel consumption in the haul truck fleet • Repair, resurfacing, splicing of conveyor belts • On-line temperature sensing for Conveyor Belts • Achieve reduction of fuel, CO2 emissions and electricity at the mine site • Eliminate and/or reduce silica in the hydraulic oil of 390F excavators. • Efficient tipper weighing system • Preventive methods for crashes and/or rollovers in mobile equipment • Preventing ore from sticking to the hopper of dump trucks • Methods to mitigate copper aging in stocks • Detection of cuts in canvas belts

Source: Linkminers, Available online: www.linkminers.com/problemas

Annex 5. Mining needs - Core Processes category; subcategory Crushing and Grinding, 2020-2022

2022	• Remote Operation of Rock Breakers • Isamill stoppage prediction using Machine Learning • Online Vibrational Analysis Monitoring • Alloy optimization to minimize ball wear in mills • Early identification of interferences in electromechanical projects (Plant)
2021	• Grinding circuit predictability and optimization • Measurement of ball mill internal parameters • Development of asset monitoring deployments at PHD honeywell • 3D printing of parts and/or primary crusher • Pebbles Plant Crusher Maintenance - Antamina • Portable platform for safe access to cyclones nest for maintenance • Crushing automation with focus on tonnage and conveying speed • Improvement of the ball addition measurement system in ML002 mill.
2020	• Efficiency for changing SAG mill plates • Prevent Ball Mill Discharge Screen Failures • SAG mill and ball mill liner replacement service • Mechanical maintenance and lining services in grinding zone • Replace NaHS use in Molybdenum plant • Counting of steel grinding media • Metal detection and/or separation system for the crushing circuit. • Upgrade crushing system • Evaluate the use of gravimetry in the grinding circuit.

Source: Linkminers, Available online: www.linkminers.com/problemas

Annex 6. Mining needs - Core Processes category; subcategory Exploration and mine and geological planning, 2020-2022

2022	• Improvement of granulometric prediction of %Fines with machine learning • Container protection and securing
2021	• Piping materials • Diamond drilling company required (labor only) • Provision of survival kit suitable for exploration projects • Training in Machine Learning with geological applications (Advanced Analytics) • Use of drones for topographic surveys and orthophotos
2020	• Adaptation of "LIDAR" technology in topography drone.

Source: Linkminers, Available online: www.linkminers.com/problemas

Annex 7. Mining needs - Core Processes category; subcategory Leaching, Concentrator Plant and Smelter, 2020-2022

2022	• Consulting services to optimize lime slurry preparation process • Over foaming in the concentrate thickener • Search for suppliers to supply Oerlikon brand solders
2021	• Reagent to replace cyanide • Ultrasonic washing equipment for ceramic filter plates • pumps required for mineral flotation reagents • Improve coordination between PREGNANT line protection systems. • Copper loss due to presence of clays, carbonates and magnesium in flotation • Reduction of power consumption of SAG mills during peak hours. • Short circuit detection of electrolytic cells by voltage monitoring • Predictive maintenance service to gold processing plant • Deterioration of acid washing reactor • Prevention of caliche generation in Pregnant solution pumping • Search for gold desorption process efficiency
2020	• Development of predictive models for copper flotation recovery • Improving water recovery in tailings thickeners • Mechanical maintenance, cleaning and lining change in flotation zone. • Predictive maintenance and monitoring of electric motors • Increase the % of gold recovery

Source: Linkminers, Available online: www.linkminers.com/problemas

Annex 8. Mining needs - Core Processes category; subcategory Drilling and Blasting, 2020-2022

2022	• Reducing overburden in subway mining advance workings
2021	• Geotechnical instrumentation supply and installation services
2020	• Instrumentation to measure temperatures inside drill holes • Real time visualization of the bottom of the long borehole pit • Drilling and blasting service for the Area 5 waste dump project • Drilling of 03 waste rock pits • Optimization of drilling and blasting process in subway mining • Reducing the deviation of long drill holes to less than 2%.

Source: Linkminers, Available online: www.linkminers.com/problemas

Annex 9. Mining needs - Smart Mine category (digital, automated, and autonomous), 2020-2022

2022	• Time attendance clocks • Systematized control of laundry service in mining camp
2021	• Identification and quantification of mineralogical species online • Digital twin for wear prediction in ball mill elements • Systematization of the drainage system of pumping pits • Implementation of devices in trucks for dashboard visualization • Subsurface-to-surface data transmission • Industrial sirens with multiple alarm types • Technological renovation of the mine's interior communications system. • Intrusion warning system in operation areas. • Implementation of a platform for concentrate fleet management. • Database system for subway operation with Dispatch integration. • Detection of excavator GETS loss through Video Analytics • Implementation of augmented reality in mine and plant maintenance works. • Automation of procurement process and local services • Electric pick-up trucks for mining operations.
2020	• Intelligent Dashboard for monitoring and control of plant and mine equipment • Development of an application to digitalize expense reports • Digitization and online monitoring of maintenance management • Real-time management of fire system events • ERP - Mineral processing plant • Automation of pumping system of water management system • Device to monitor contact between people • Automation, process control and electrical maintenance services • Telepresence • Elaboration of the digital strategic roadmap • Development of a low-cost sensor to be installed in seat belts • Electronic device for wireless lamp for tracking people • Aerial monitoring and alert of personnel detection in restricted areas

Source: Linkminers, Available online: www.linkminers.com/problemas

Annex 10. Mining needs - Sustainable Mine category (Environment and Communities), 2020-2022

2021	• Pre-treatment for water with high sulfate content • Improve tailings dam; dam construction process • Particulate matter measurement equipment for smelter chimney • Development or implementation of local supplier management system • Search for efficient methods and/or efficient treatment of tailings • Reducing carbon footprint and energy efficiency • Reducing carbon footprint for fuel for mobile equipment in the pit • Inclusion in the labor market through basic education for adults • Business model for rural community connectivity • Biosafety equipment for Covid-19 exposed personnel
2020	• Desalinization of water for a continuous flow of 100-150 m3/day • Identification of water wells • Implement monitoring and social distancing device for covid-19 • Photovoltaic power generation system • Measurement of flow rates in open channels • Contagion prevention and isolation method in rooms against Covid-19 • Covid-19 sanitation • Preventing risk of entry and early identification covid-19 • Detection, monitoring and care of mine personnel for covid-19 • Drones, cabins or other mechanism for sanitization of mining operation • Environmental monitoring • Implement a control system for social projects

Source: Linkminers, Available online: www.linkminers.com/problemas

Annex 11. Mining needs - Other's category, 2020-2022

2022	• Search for water supply sources within a 60 km radius • Digital interpreter system • Electropump for pit dewatering, superior to 200HP with a flow rate of 250m3/h • Improved control, distribution and storage of sands and aggregates.
2021	• Optimization of shotcrete setting time via wet process • Detection and safe positioning of yellow line units • Alternatives to lining / waterproofing of channels and pit walls • Improve in-plant lock out tag out management • Improve communications in the face of radio signal saturation at the mine site • Fast and efficient methods for disinfecting truck cabins • Alternatives for alcohol testing to avoid covid exposure • Inbound logistics management, planning, control and monitoring platform • Warning systems in self-rescue zones • Firefighting system for natural gas line • Development of seismic early warning system • Air purifiers for administrative offices • Change management to exploit mining areas with temperatures above 55°C • Disinfection of bedding accessories and hotel equipment in mining camp • Remote soil moisture and soil compaction measurement

Source: Linkminers, Available online: www.linkminers.com/problemas