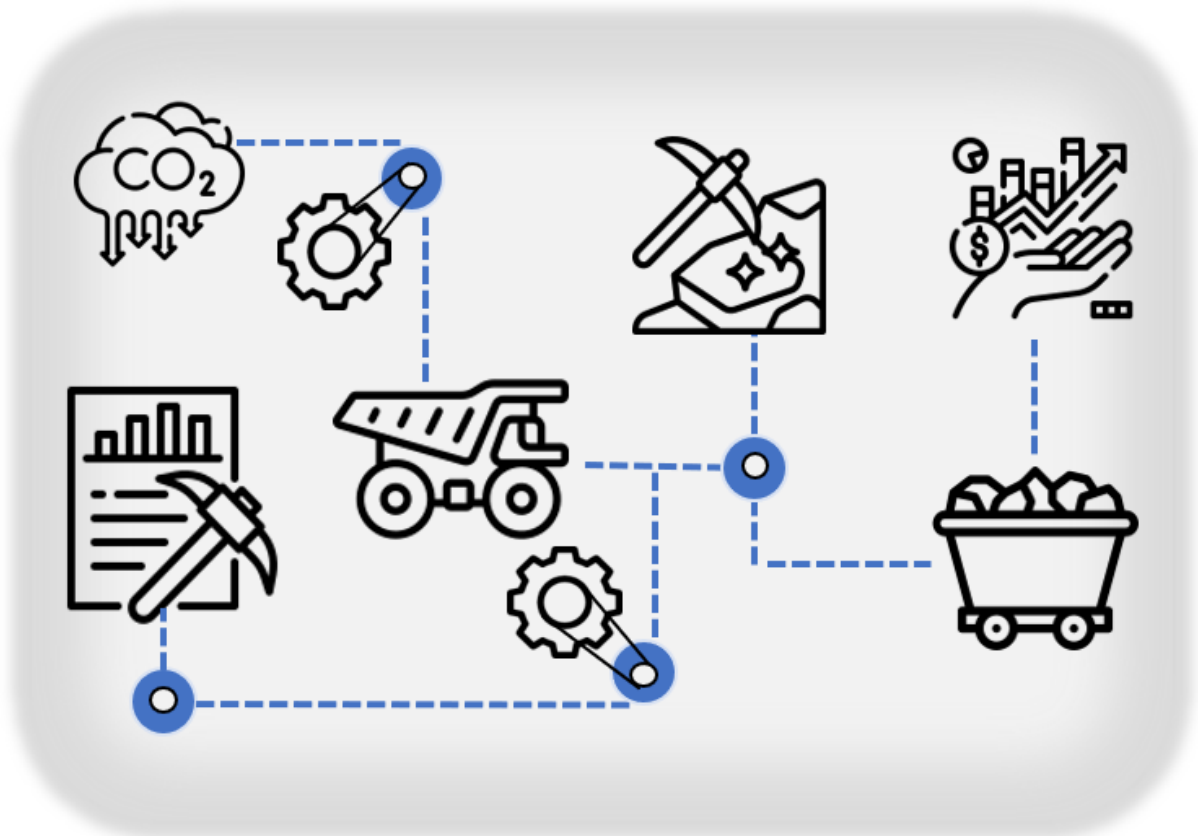


VALUE CHAINS IN MINING PERU

A growing and dynamic market (Part 1)



Official Partner

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
VAT
WTO

Unified Ordered Text
Value Added Tax
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. Swiss suppliers and technology for mining

Some Swiss firms work closely with mining firms in Latin America. Their products are briefly presented thereafter.

- **ABB:** leader in energy, industrial automation and digital technologies; main products and services cover distributed control systems, automation systems, medium and low voltage electric motors, instrumentation and control.
- **Sulzer:** supplier of pumps and agitators for mines, from the water intake to the final stages of production. Much of the equipment has environmental relevance, either for the transport of aggressive fluids that may not escape into the environment or for equipment used in wastewater treatment.
- **Sika:** offers final products and solutions for underground and open sky mines such as applications for waterproofing, concrete, flooring and roofing. Sika contributes to the environment by reducing CO₂ and other emissions at all manufacturing steps, reducing non-recyclable waste and waste, reducing polluting substances, promoting clean energy in production processes.
- **Leica:** is specialized in digital and analogue cameras, innovative microscopy, biosystems for laboratories and products, software and systems that process 3D spatial data. Focus more on safety and resource planning than on the environmental aspect. Truck fleet control systems seek to optimize all resources during the production process.
- **Geobruigg:** leader in supplying high tensile steel wire safety nets and meshes; they are used for reliable protection against natural hazards such as rock falls, landslides, avalanches, or as a safety measure in construction and mining tunnels. They are characterized by their robustness, high energy absorption capacity and extreme durability.
- **Geotest:** specialized in geology and construction ground, groundwater and geothermal energy, environment and contamination, raw materials and landfills, geoinformatics and 3D modelling. Participates in the geological assessment and mineral exploration phases; supports environmental impact assessments in the area

of geological and glacier risks, installs warning systems and contributes to the protection of the environment.

- **Endress+Hauser**: active in the extraction and refining phases; supply of products that help optimize production processes, guarantee operational safety and increase environmental compliance. Some products help mitigate the impact on the environment: wireless transmitters for the detection of analytical variables and flow meters for better control of water resources.
- **SICPA**: in the process of developing business with the mining sector by offering solutions related to traceability in the mine for resources and processes.
- **Marti**: construction firm specialized i.a. in earthworks, special works, sawing and core drilling and civil engineering. The firm offers elevated drilling services (Raise Boring). It is used to drill ventilation chimneys, transfer ore from one level to another, and create silos to store the rock and to bring the rock and ore to the surface. Contributes to the protection of the environment by being safe, without the use of explosives and without fracturing the rock associated with explosions. It is a stable and precise circular excavation that does not damage the side walls of the hole or well.
- **Hilti**: leading firm in construction providing lightweight tools and fastening systems with safety features.
- **Argor Heraeus**: refines gold; for traceability, use of 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.
- **Ganser**: Common Rail injection technology, which contributed significantly to the new era of the modern diesel engine. The diesel engine becomes more powerful, runs quietly and produces far less emissions than in the past. The Common Rail injection system is an engine-internal measure to reduce the environmental impact in contrast to exhaust after-treatment systems, which are added components on the engine. It can also be applied to the engines of very large trucks operating in mines. Thus far, Ganser has not been active in South America.
- **Soleol**: offers services as an integrator installing photovoltaic panels and saving thereby energy; mines are located in areas with a very high resolution of the sun and a very high capacity to generate solar energy. Soleol aims at private and industrial customers, farmers, but also at public authorities and all the actors of the real estate sector (architects, management companies, general contractors). Services also include solar carport, solar battery, charging station and monitoring system. The mining sector bears a very significant potential for solar energy integrators. SOLEOL has a subsidiary in Peru with 17 employees.
- **Wyssen Avalanche Control**: offers a reliable and effective remote avalanche control system. By 2020, the company had installed over 550 Wyssen avalanche towers worldwide.

3.2. Peruvian demand in the mining value chain

The main stages¹ 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, Antamina² 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 Verde³ 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 Linkminers⁴ 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:

¹ Available online: www.minem.gob.pe/minem/archivos/file/institucional/regionales/Publicaciones/Guia-Peque%C3%B1os-Artesanales.pdf

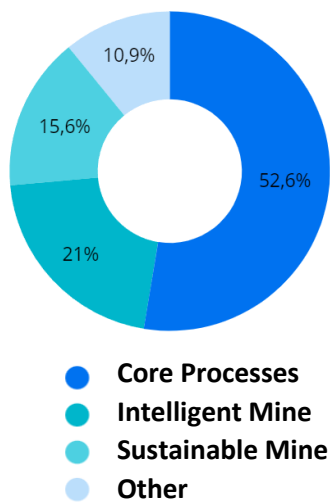
² Available online: <https://25n9v12xdmru2v4k1z46yi4o-wpengine.netdna-ssl.com/wp-content/uploads/2021/09/sustainability-report-antamina2020.pdf>

³ Available online: www.cerroverde.pe/assets/img/publicaciones/mineria-cobre-molibdeno-arequipa-minera-cerro-verde-peru-reporte-2020.pdf

⁴ Available online: <https://datastudio.google.com/reporting/d02ea28c-f7f7-40ed-8557-4b2824ed31d6/page/Cx52B?s=qqhcMb2P6g4>

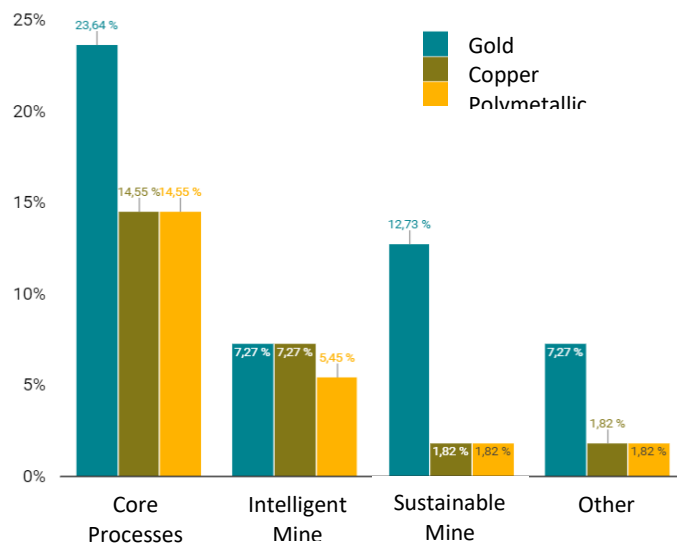
1. **Core Processes:** category with the highest number of needs aimed at generating efficiency, increasing productivity and modernizing central technologies in the operation and maintenance fronts.
2. **Smart Mine:** oriented towards the adoption of Industry 4.0 technologies with a focus on data-driven 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 1. Structure of mining needs



Source: Linkminers

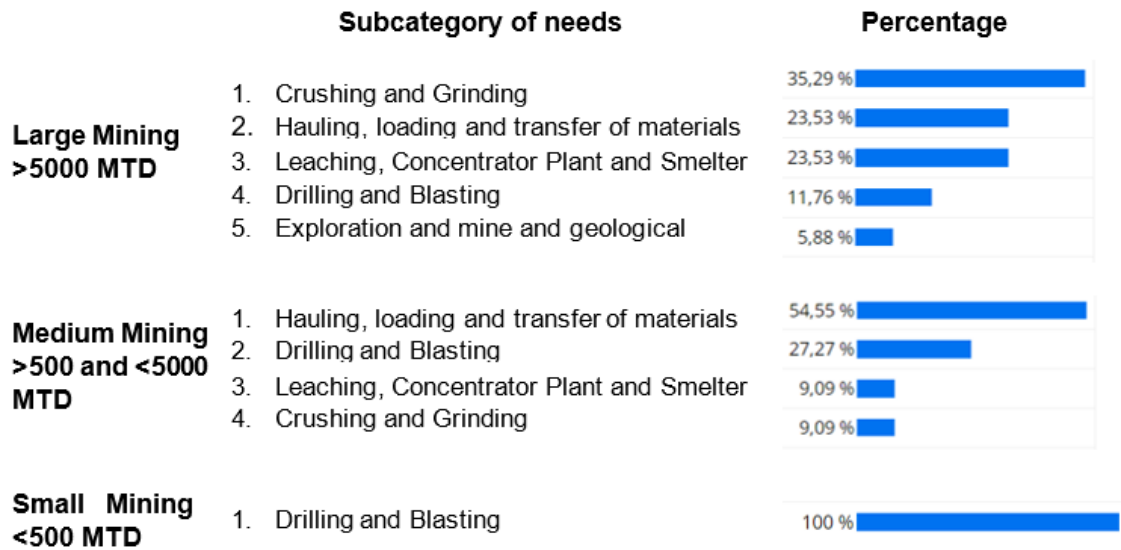
Figure 2. Needs classified by mineral type



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 3). Further details on the goods and services needed by Peruvian mining companies are available in annexes.

Figure 3. Core Process Subcategories

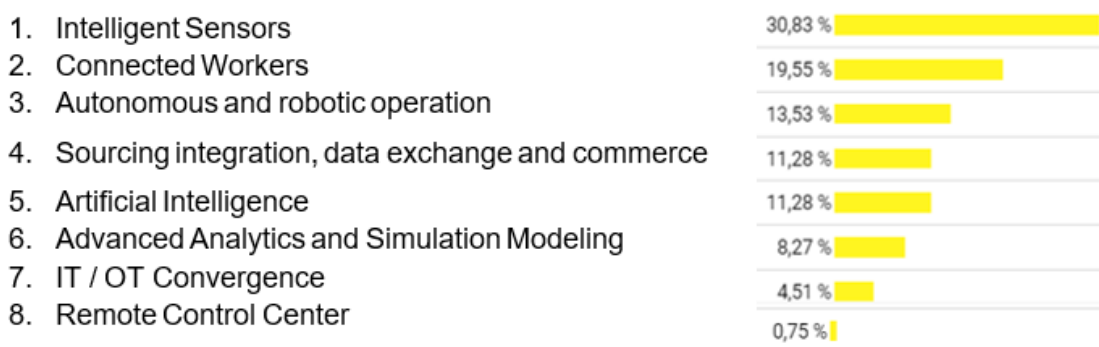


Note: metric tons per day (MTD)

Source: Linkminers

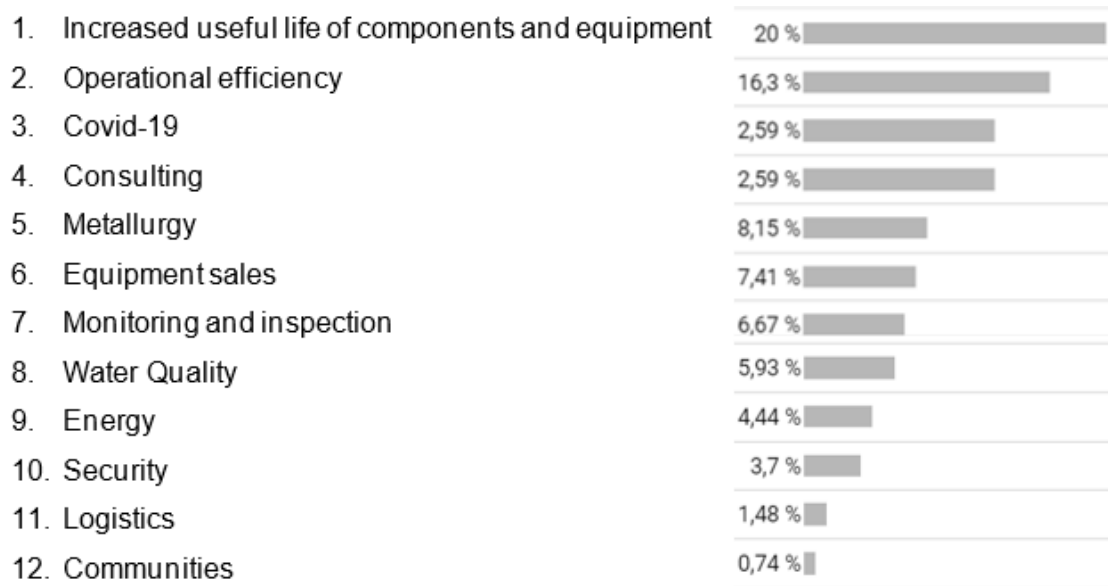
These needs reported by mining companies generated 268 solution proposals from suppliers from 15 countries, 78% of which are distributors of foreign companies in Peru. Fifty percent of the proposals included a digital component and half of them referred to "Core Process" needs incorporating smart sensor 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 4. Digital solutions



Source: Linkminers

Figure 5. 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 Linkminers⁵, provides a baseline from which to define goals and objectives for mineral growth and development.

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.

- 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.

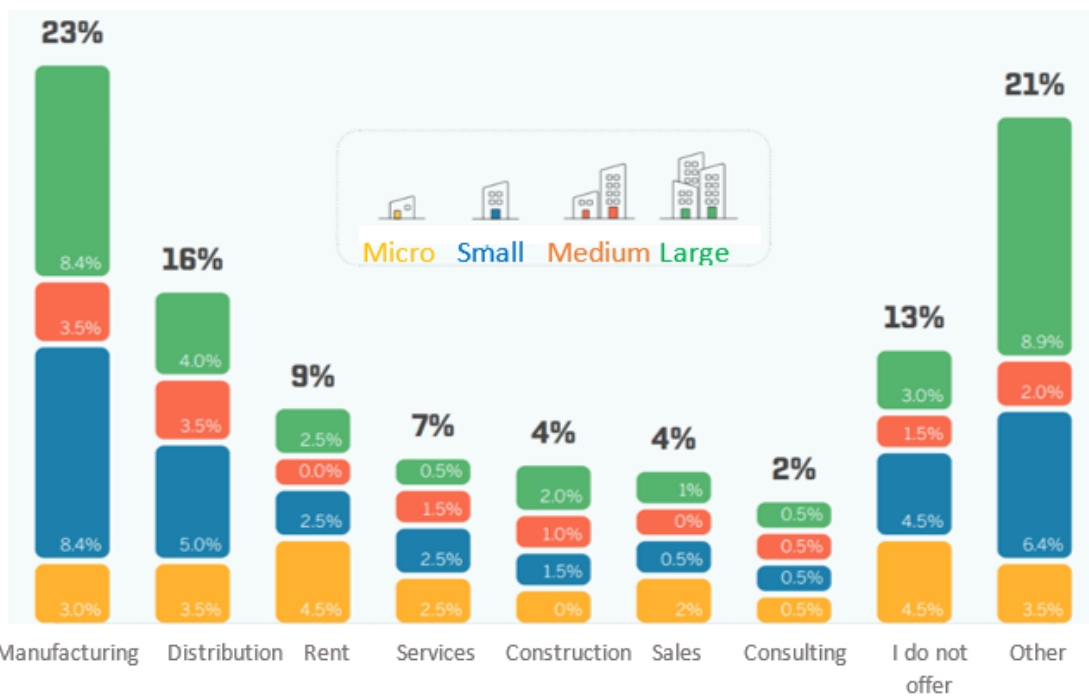
⁵ Available online: www.sammi.pe/noticias/primer-estudio-de-proveedores-mineros-del-peru-2021

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

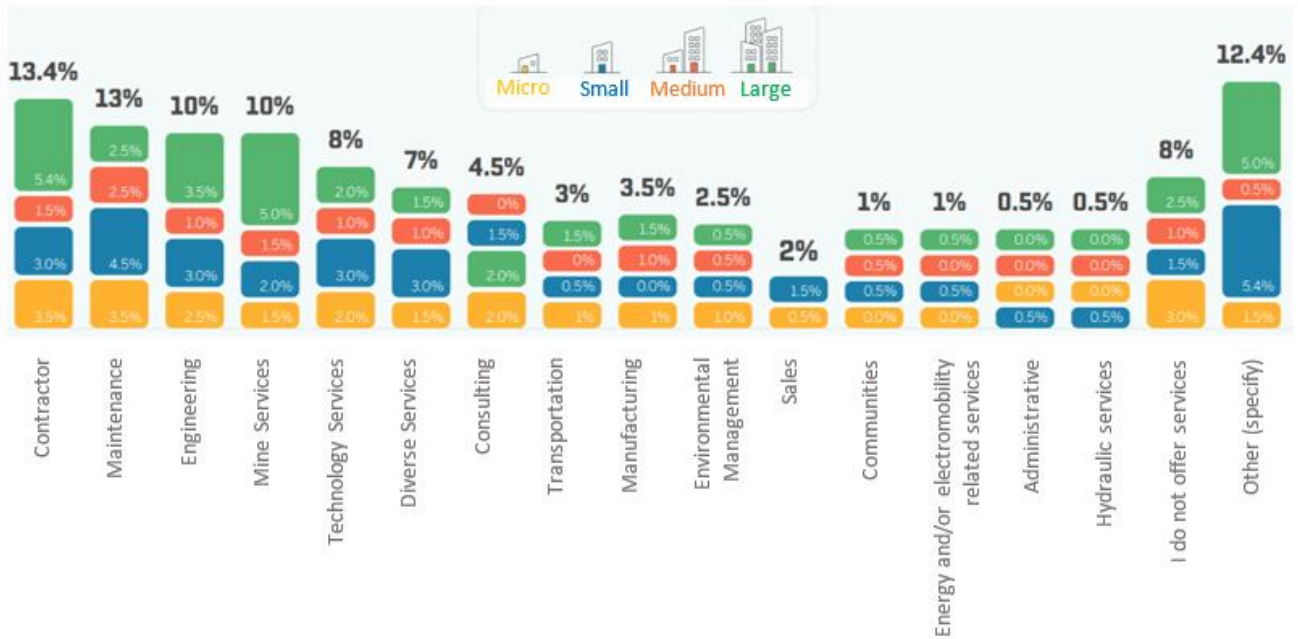
Companies that offer equipment specialize mainly in manufacturing (23%) and distribution (transportation of the mining products) (16%), while 13% do not offer equipment and focus only on providing services. The companies specializing in equipment are mainly companies with more than 20 years in the market and concentrated in medium and large companies (see figure 6). 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 7).

Figure 6. Equipment suppliers by industry or specialty



Source: Study of Mining Suppliers in Peru - 2021

Figure 7. Service providers by industry or specialty



Source: Study of Mining Suppliers in Peru - 2021

3.2.1. 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. 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.

4.1. Mining opportunities

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 out⁶.

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

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

4.2. 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.

⁶ Available online: [https://iimp.org.pe/raiz/este-ano-compras-de-mineria-a-proveedores-nacionales-llegarian-a-us\\$-10,300-millones](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 1. 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 CO₂ 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)
- Outsourcing: 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.

4.3. 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 Scouting⁷ 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.

4.4. 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" report⁸ 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.

⁷ Available online: www.minergyconnect.pe/en/scouting-snmpe

⁸ 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.

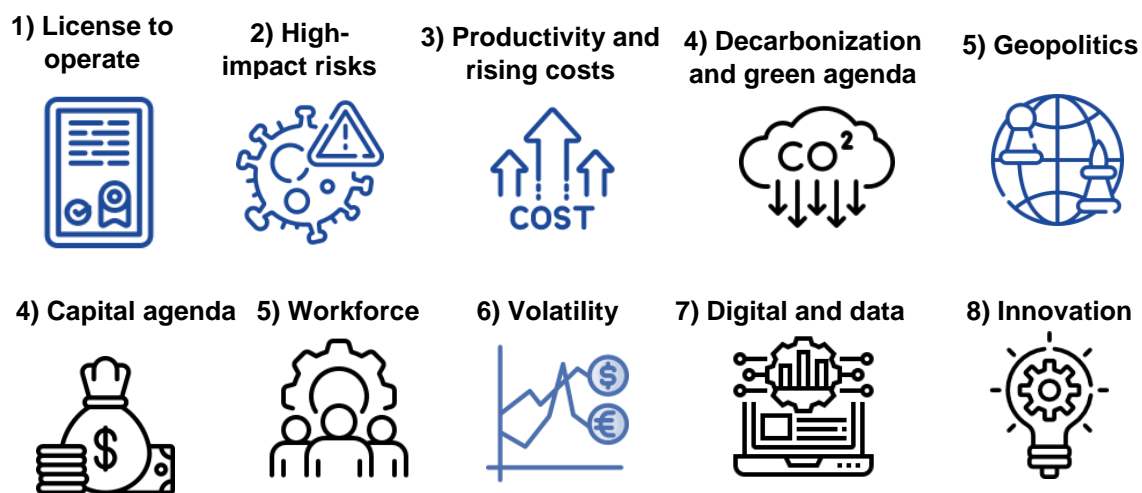
Macroeconomic policy is one of Peru's strength with a rigorous monetary and fiscal policy over many years. This has contributed to achieving one of the highest growth rates in Latin America during the past decade. However, the current political situation, characterized, among other things, by constant 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 & Young⁹ 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 8. 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.

⁹ 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.

5. 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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6. ANNEXES

Annex 1. Illegal Mining and Informal Mining

Illegal mining	Informal mining
<p>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.</p>	<p>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.</p>
Differences¹⁰	
<ul style="list-style-type: none"> - 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. 	<ul style="list-style-type: none"> - 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 N° 1105 & Ministry of Environment, 2016

¹⁰ Ministry of Environment. (2016). Sectoral report of the environment "The struggle for legality in the mining activity 2011-2016".

Annex 2. Mining needs - Core Processes category; subcategory Hauling, loading and transfer of materials, 2020-2022

2022	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 IoT 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	<ul style="list-style-type: none"> • 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 3. Mining needs - Core Processes category; subcategory Crushing and Grinding, 2020-2022

2022	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 4. Mining needs - Core Processes category; subcategory Exploration and mine and geological planning, 2020-2022

2022	<ul style="list-style-type: none"> • Improvement of granulometric prediction of %Fines with machine learning • Container protection and securing
2021	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Adaptation of "LIDAR" technology in topography drone.

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

Annex 5. Mining needs - Core Processes category; subcategory Leaching, Concentrator Plant and Smelter, 2020-2022

2022	<ul style="list-style-type: none"> • Consulting services to optimize lime slurry preparation process • Over foaming in the concentrate thickener • Search for suppliers to supply Oerlikon brand solders
2021	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 6. Mining needs - Core Processes category; subcategory Drilling and Blasting, 2020-2022

2022	<ul style="list-style-type: none"> • Reducing overburden in subway mining advance workings
2021	<ul style="list-style-type: none"> • Geotechnical instrumentation supply and installation services
2020	<ul style="list-style-type: none"> • 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 7. Mining needs - Smart Mine category (digital, automated, and autonomous),
2020-2022**

2022	<ul style="list-style-type: none"> • Time attendance clocks • Systematized control of laundry service in mining camp
2021	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 8. Mining needs - Sustainable Mine category (Environment and Communities), 2020-2022

2021	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 9. Mining needs - Other's category, 2020-2022

2022	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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