



PERÚMIN hub

Comunidad
de Innovadores

**Guideline
2022**

PERUMIN Hub

PERUMIN Hub, the main open innovation program in the mining sector in Peru, seeks solutions to the great challenges of the mining sector through collaborative innovation. This program was born from the alliance between the Institute of Mining Engineers of Peru (IIMP) and the Mining Innovation Hub of Peru (Hub), institutions committed to charting a path to position mining as a sector that innovates in community, and to guide innovators facilitating their growth, consolidation and commercial takeoff in the mining sector.

PERUMIN Hub has been structured in three stages:

1. Challenges

In our 1st edition 2021, important partners in the sector joined forces to prioritize, based on their studies and technical background, three thematic areas that represent important opportunities to address through innovation, Environment and Sustainability, Mining 4.0 and Water Resources. Likewise, the main mining companies of the country joined forces to identify the main common challenges in these three thematic areas.

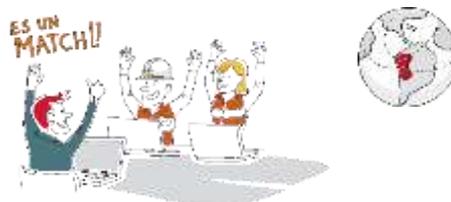
In this 2nd edition, not only common challenges among mining companies are presented, but also challenges shared with key actors in the sector. These challenges are the result of a reflective process that began with a c-level discussion around the major challenges and that, added to an organizational culture of innovation promoted within the mining companies and key organizations in the sector such as the Government and Academia, has allowed the identification and characterization of the main challenges, making them available to the different innovation groups for the search for solutions in community.



2. Matchmaking: in this stage, collaboration is actively promoted through linking spaces between innovators, as well as innovators and mining companies. This process is supported by 2 free and complementary platforms to the contest:

- a. Matchmaking 1 (MM1): in this platform, national and international innovators connect to complement technological, technical, commercial and sector experience strengths, among others. The platform is designed based on information that allows you to suggest and demonstrate complementarities.

The matchmaking 1 process aims to connect potential solvers so that they can apply, at the competition stage, with more robust proposals resulting from a collaborative/partnership work.



In the evaluation process of the Call stage, those proposals in collaboration/partnership, because of the MM1 or other process coordinated by the innovators, will be positively valued.

- b. Matchmaking 2 (MM2): on this platform, potential solvers could, prior to the competition, voluntarily and optionally submit a profile of their proposals to receive feedback from the internal teams of the mining companies participating in the PERUMIN Hub, with the objective of connecting them with potential users to adjust their proposals, based on the comments received.



In the evaluation process of the Call stage, those proposals that have generated the greatest expectation among the internal teams of the mining companies, measured as the number of "The solution is innovative and of interest to the sector" on the MM2 platform, will be positively evaluated.



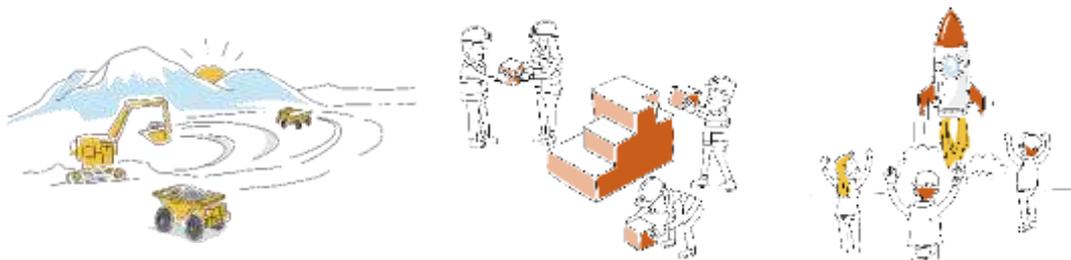
- 3. Call: at this stage the innovators present their solutions in response to the challenges of mining companies. These guidelines consider the most relevant aspects for the fulfillment of the objective of this stage.

For more information about the PERUMIN Hub program and its stages visit our website www.perumin.com/en/hub.

PERUMIN Hub: Call

1. What are the objectives of the contest?

- ✓ Promote the development of innovative solutions that respond to specific challenges of the mining industry.
- ✓ Facilitate the consolidation of innovations through collaboration.
- ✓ Recognize successful innovations and promote their commercial take-off in the sector.



2. What are the challenges facing the mining industry?

The main challenges identified are the result of the combined efforts of important partners from the mining industry and the organizations involved through studies and technical projects. These are grouped into 3 thematic areas and respond to 11 key challenges:

2.1 Water Resources



For the second consecutive year, the social license to operate is considered the greatest risk faced by the mining industry worldwide, and within this risk, water resource management is presented as the second most influential factor.

In Peru, although mining uses only 1.5% of available water, it accounts for more than 65% of authorized industrial wastewater discharges.

- Challenge 1: How to optimize water use and reuse in mining operations?
- Challenge 2: How to promote an integrated and participatory water resources management?
- Challenge 3: How to make regulatory processes more efficient, generating shared value between the mining company and the Government?

2.2 Environment and Sustainability



The main challenge of the expansion of mining activity lies in the level of sustainability that can be achieved. This is essentially based on the efficient use of natural resources, as well as on its environmental footprint. As a result of the absence of environmental awareness and regulation, the Peru of the past left us with more than 8,000 environmental mining liabilities (most of which have no identifiable responsible parties), of which only about 1,000 are in the process of remediation.

- Challenge 1: How to reduce, treat, take advantage of and/or improve the disposal, use and reuse of tailings and/or waste rock dumps and/or environmental liabilities?
- Challenge 2: How to implement technologies in operations to become a carbon neutral activity?
- Challenge 3: How to incorporate into mine closure technologies that facilitate efficiency in mine closure processes?
- Challenge 4: How to incorporate models that generate shared value in mine closure?
- Challenge 5: How to generate shared value through the inclusion of economic, social, environmental and/or information and knowledge infrastructure?

2.3 Mining 4.0



The fourth industrial revolution is already a challenge that cannot be postponed in the mining sector and the current situation makes it even more urgent. Technologies such as the Internet of Things, Artificial Intelligence, virtual reality, robotization, Cloud, Big Data, cybersecurity, 3D printing, among others, are applicable to every stage of the mining business, from exploration to the closing of operations. Their applicability not only increases productivity, but also contributes to better environmental and social performance.

- Challenge 1: How to improve productivity and efficiency in operations by leveraging 4.0 technologies and facilitating their adoption?
- Challenge 2: How to increase personnel safety through digitization throughout the entire operation?
- Challenge 3: How to incorporate technologies that guarantee cybersecurity in the mining company in the face of the use of 4.0 technologies?

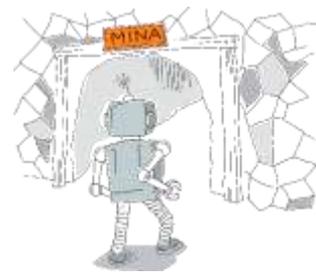
The technical details of each challenge can be found in Annex 1.

3. What kind of solutions does the competition seek?

We are looking for innovations with a certain degree of development/maturity according to the following categories:

3.1 Category 1: Innovations to be validated

This category is aimed at preliminary innovative solutions that have already passed the conceptual validation phase and have a **prototype to be validated**¹, as well as a validation plan that can be implemented for the first time in a mining company. The solutions presented in this category must respond in a timely manner to one or more of the challenges prioritized in this second edition.

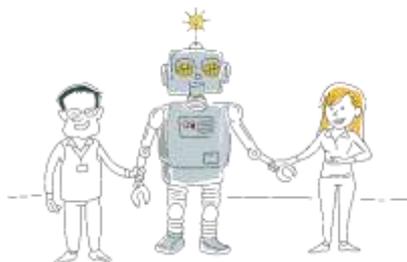


3.2 Category 2: Successful innovations

This category is aimed at **innovative solutions** that have already been **tested and validated**² **in the field** (mining companies or centers that simulate real conditions), Peruvian or from another country, with satisfactory results obtained **in recent years (2019-2022)**. Innovations submitted in this category should only be framed within one of the thematic areas presented above: i) Environment and Sustainability, ii) Water Resources, and iii) Mining 4.0.

¹ As a reference this category is aligned to TRL4 and TRL5, proposals in idea stage (TRL1 to TRL3) will not be accepted. For more details: <http://vinculate.concytec.gob.pe/niveles-de-madurez/>

²For reference this category is aligned to TRL6 to TRL9. For more details: <http://vinculate.concytec.gob.pe/niveles-de-madurez/>



3.3 Category 3: Innovative collaborative models

This category is aimed at innovative solutions where, regardless of the technological tools that can be used (it is not a requirement), the work model and the potential impact beyond the mine through the generation of shared value are the focus. The model may be in a phase to be validated or validated in the mining sector or other sectors or industries.



4. Who can apply?

4.1 Category 1: Innovations to be validated

Participation in category 1 is divided into 3 subcategories:

- Domestic companies:** companies headquartered in Peru³.
- International companies:** companies headquartered outside Peru.
- Universities:** universities based in Peru represented by a recognized unit in their organizational structure such as School, Faculty, Laboratory, Research Office, Research Group, Incubators, among others.

In the three subcategories, the application can be made individually or in collaboration with companies and/or R&D entities⁴ national or international.

4.2 Category 2: Successful innovations

³ It includes the companies provided for in Decree Law No. 21621, Law of the Individual Limited Liability Company (E.I.R.L.); the corporate forms provided for in Law No. 26887, General Law of Corporations, such as S.A., S.A.A.A., S.A.C., S.R.L., Sociedad Civil, Sociedad Civil Ordinaria, S. Civil de R.L. as well as branches in Peru of a foreign company in accordance with article 403 of the General Law of Corporations.

⁴ Universities, research centers or institutes.

Participation in category 1 is divided into 2 subcategories:

- a) **Domestic companies:** companies headquartered in Peru³.
- b) **International companies:** companies headquartered outside Peru.

In both subcategories, applications can be made individually or in collaboration with national or international companies and/or universities.

4.3 Category 3: Innovative collaborative models

Companies, universities, and national and international associations or NGOs may participate. However, in the case of international entities (without headquarters in Peru), they must have a Peruvian partner who will be in charge of leading the application.

Note: Finalists/winners in the PERUMIN Hub 2021 edition will not be able to participate in the three categories with the same solution with which they were selected. However, they may participate with another solution or with the same solution only if it has changed of category from validating innovations to successful/validated innovations.

5. How to apply for the contest?



To apply, the proposal must be submitted through the following link <http://bit.ly/peruminhub-concurso> completing all the items of the proposed form, according to the schedule detailed in section 8.

6. What are the contest requirements?

- 6.1 Letter of Presentation (Annex 2):** Must be signed by an authority of the applicant entity. Applies to all 3 categories.
- 6.2 Letter of alliance (Annex 3):** Must be signed by an authority of the allied entity(ies). Applies to all 3 categories for those proposals participating in collaborative mode.
- 6.3 Field validation document (Free format):** Must be signed by an authority of the organization or company where the field validation has been performed. Applies to Category 2, successful innovations; and Category 3 in case the model has been validated.

The required document is free format and should only contain explicitly the following information:

- ✓ Name of the organization or company where the field validation was performed.
- ✓ Name of the entity/company applying.
- ✓ Name of the project and/or technology to be validated.
- ✓ Favorable validation results.
- ✓ Validation end date (month and year).

7. How will the evaluation and selection be carried out?



The evaluation process will be carried out in three stages:

7.1 Technical evaluation: at this stage all solutions will be evaluated by experts in the technologies or subject matter to be qualified, through PERUMIN Hub allies. This evaluation will pre-select the innovations that will go to a second stage of evaluation at the user level.

7.2 User-level evaluation: the innovative solutions must respond to the specific needs of the mining companies, which, through their representatives, will be responsible for selecting the finalists. For this purpose, the solvers that have passed the technical evaluation will have to present their solutions clearly, precisely and dynamically at the scheduled Demo Days.



At these Demo Days, mining companies will know at first-hand the solutions that the community of innovators has developed, selecting

15 finalists who will be able to present their proposals at the PERUMIN 35 Mining Convention. The selection of finalists will be subject to the passing grade by the evaluators, but the following distribution will be used as a guideline:

	Environment & Sustainability	Water Resources	Mining 4.0	Total
Category 1: Innovations to be validated	3 finalists per subcategory: national companies, international companies, and universities.			9
Category 2: Successful innovations	2 finalists per subcategory: national companies and international companies.			4
Category 3: Innovative collaborative models	2 finalists.			2
Total				15

7.3 The exhibition, final evaluation and announcement of best solutions will take place during the week of September 26-30 at the PERUMIN 35 Mining Convention.

7.4 PERUMIN Hub will cover travel expenses: round-trip airfare within the Peruvian territory with destination the city of Arequipa, as well as lodging for 1 representative per finalist entity according to the dates of presentation.⁵



All evaluation stages will consider the following criteria, according to category:

Category 1: Innovations to be validated

⁵ Flight schedules and lodging locations will be determined by PERUMIN Hub, any modification or change will be at the expense of the participants. Likewise, the distribution of accommodation could be in double rooms. Local transportation, food and other expenses not mentioned are not included.

Criteria	Description	Weight
Importance	The solution is relevant, pertinent and of clear benefits in response to the challenge.	25%
Innovation	The solution is novel and innovative with respect to the local and/or international market, in relation to the challenge. It will be considered positive to have registered intellectual property.	25%
Feasibility	The proposed implementation plan is feasible and consistent with the expected results.	30%
Sustainable Development	The solution has social and/or developmental impact linked to the Sustainable Development Goals (SDGs).	10%
Collaboration	The solution is the result of a collaborative strategy between two or more entities.	5%
Expectation	The solution has generated interest among potential users. The number of "The solution is innovative" will be taken as a reference, because of the feedback from the mining companies in "Matchmaking 2".	5%

Category 2: Successful innovations

Criteria	Description	Weight
Importance	The innovation presented is relevant and of clear benefits in relation to the subject area and the Peruvian mining industry.	30%
Innovation	The solution is novel and innovative with respect to the local and/or international market. It will be considered positive to have registered intellectual property.	20%
Scalability	Innovation has a high potential for adaptation and expansion in the market.	35%
Sustainable Development	The solution has social and/or developmental impact linked to the Sustainable Development Goals (SDGs).	10%
Expectation	The solution has generated interest among potential users. The number of "The solution is innovative" will be taken as a reference, as a result of the feedback from the mining companies in "Matchmaking 2".	5%

Category 3: Innovative collaborative models

Criteria	Description	Weight
Importance	The innovative collaborative model presented is relevant and of clear benefits in relation to the challenge and the main actors involved.	30%
Innovation	The model is new and innovative in the sector.	15%
Feasibility	The proposed implementation plan is feasible and consistent with the expected results.	30%

Sustainable Development	The solution has social and/or developmental impact linked to the Sustainable Development Goals (SDGs).	20%
Expectation	The solution has generated interest among potential users. The number of "The solution is innovative" will be taken as a reference, as a result of the feedback from the mining companies in "Matchmaking 2".	5%

8. Schedule

Activity	Date
Launching of the Call	May 17, 2022
Matchmaking 1	March 10 to July 18, 2022
Matchmaking 2	April 1 to April 28, 2022
Start of applications	Tuesday, May 17, 2022
Closing date for applications	Monday, July 18, 2022 23:59 hours (UTC-5)
Announcement of pre-selected and schedule of presentations	August 22 to 26, 2022
Demo Days	From August 31 to September 05, 2022
PERUMIN 35th Mining Convention	September 26 to 30, 2022

9. Consultations

If you have additional questions, please do not hesitate to contact us by e-mail at peruminhub@iimp.org.pe or visit our website www.perumin.com/en/hub.

10. General Provisions

- 10.1** PERUMIN Hub reserves the right to disqualify participants if it detects proposals with false information, that violate intellectual property or that fail to comply with the requirements and/or provisions at any stage of the program.
- 10.2** PERUMIN Hub has exclusive authority to interpret the scope of the provisions contained in these Guideline.
- 10.3** PERUMIN Hub is committed to non-disclosure or share sensitive information regarding the project without the prior knowledge and

consent of the participant. In the case of evaluators, confidentiality agreements will be used.

- 10.4** PERUMIN Hub will not participate in or be responsible for the agreements made by the participating entities in the processes of collaboration, alliances or others. The actions taken, in a potential implementation of the proposed solutions, will be in agreement with the parties involved, escaping the scope of this Call.

Annex 1. Characterization of thematic areas and challenges

The challenges are grouped into 3 thematic areas and 11 key challenges⁶:

1.1 Water Resources



For the second consecutive year, the social license to operate is considered the greatest risk faced by the mining industry worldwide, and within this risk, water resource management is presented as the second most influential factor.

In Peru, although mining uses only 1.5% of available water, it accounts for more than 65% of authorized industrial wastewater discharges.

Challenge 1: How to optimize water use and its reuse in mining operations?

Sustainable Development Goal 6 (Ensure availability and sustainable management of water and sanitation) has as one of its targets to significantly increase the efficient use of water resources in all sectors and ensure the sustainability of freshwater extraction and supply to address water scarcity and significantly reduce the number of people suffering from water scarcity.

Mining companies and allies are looking for technologies that consider one or more elements of value in their proposal.

Elements of value

- Focused on reducing consumption and loss (such as water evaporation).
- Technologies that allow measuring: i) water use, ii) water losses due to evaporation, filtration and/or entrapment in tailings, iii) quantity and quality variables based on the supply Andean basins.
- Focused on circular economy that allows maximizing the number of times water is kept in the circuit, reusing it and admitting other types of water, such as groundwater.
- Incorporating water balance diagnosis with a basin approach and climate change projection.
- Aligned with Peruvian regulations, which facilitate/enable joint work with the ANA.
- Ensuring the quality of water in the discharge and post operations in a sustainable manner.
- Taking advantage of the different water sources that may be undervalued, being efficient in capturing water and/or taking advantage of different water sources that may be undervalued.

- Having a multisectoral vision (including, for example, the energy and/or agricultural sector and/or territorial (including not only the mine, but also the water sources and direct and indirect area of influence).

Challenge 2: How to promote integrated and participatory water resources management?

The mining sector is expected to contribute to the integrated management of water resources (GIRH in spanish) since the degree of water stress in basins has been increasing. This is due not only to the growth of social and economic activities, but also to the low efficiency in the management of water demand, the low quality of water resources, the high vulnerability to climate change, the weak governance in the management of the resource, coupled with the asymmetric distribution of water in quantity and opportunity in the national territory.

One of the goals for 2030, within the framework of Sustainable Development Goal 6 (Ensure the availability and sustainable management of water and sanitation) is to implement integrated management of water resources at all levels. Integrated approaches help coordinate sustainable development and water management for the entire spectrum of users and/or stakeholders involved: community, agriculture, industry, mining, user committees, Ministry of Energy and Mining (MINEM), Ministry of Environment (MINAM), Ministry of Agrarian Development and Irrigation (MIDAGRI), National Authority of Water (ANA), local governments, etc.

Mining companies, government stakeholders and unions/associations seek models/mechanisms and/or systems that consider one or more elements of value in their proposal:

Elements of value:

- Systematization/centralization of climatological and hydrological information from all stations (public and private) for decision-making, preferably in real time.
- Homologation and validation of public information such as that of the [ANA´s Water Observatory](#), [SENAMHI´s Hydrometeorological Data](#), among others.
- Putting value on open information (open data) in a transparent manner with a focus on generating trust and raising awareness among users and/or stakeholders.
- Circular approach.
- Water sources as a base unit and an opportunity to expand information about them.
- Solutions in the coastal zone.
- Making visible the contribution to water management and to the value chain, through friendly information for communities and other local stakeholders.
- Considering the roles in participatory management: i) State as the manager of water resources and ii) private companies (mining and

industry) as strategic collaborators for the management and implementation of solutions.

- Including friendly information for communities.
- Providing analysis and value to existing mechanisms such as Basin Andean Councils.
- Contributing to the implementation of the Water Resources Management Plans of Basins (for Andean basins with existing), a binding public instrument that aims to achieve the sustainable use of water resources, as well as the increase in water availability in the short, medium and long term, in harmony with national, regional and local development. Currently there are 6 completed planes on the Pacific side: [Tumbes](#), [Chira-Piura](#), [Chancay-Lambayeque](#), [Chancay-Huaral](#), [Quilca-Chili](#) and [Caplina-Locumba](#) and the Amazon side planes are in the process of being updated: [Mayo](#), [Pampas](#), [Vilcanota-Urubamba](#) and [Mantaro](#).
- Risk management in the face of climate change (the south coast being the area most affected by water scarcity).
- Making visible not only structural actions but also non-structural ones, to contribute promoting a culture of water management, considering the cultural diversity of the coastal, Andean and Amazonian populations, i.e Fundación Los Andes in Cajamarca, has the initiative of the Interactive Water and Land Museum (<https://www.losandes.org.pe/museo-de-agua-y-tierra-interactivo/>).

Challenge 3: How to make regulatory processes more efficient, generating shared value between the mining company and the State?

Regulation is born to correct market failures such as the presence of externalities, the existence of public goods, competition failures, information asymmetry, among others. At the same time, it is a key government tool to achieve social, economic and environmental goals, among others. We seek solutions that facilitate regulatory processes, generating value for the State, the territory and the mining company.

Mining companies and Government actors are looking for models/mechanisms and/or systems that consider one or more value elements in their proposal.

Elements of value

- Putting value on open information (open data) in a transparent manner with a focus on generating trust and raising awareness among users and/or stakeholders.
- Incentives that go beyond recognition and value good management practices to simplify processes. Currently the ANA has the [Blue Certificate](#).
- How to include technological trends and the participation and collaboration of private companies (international benchmark) to improve existing regulations, promoting projects and generating shared value. In this line, an escalation of corporate water management could be mentioned, that is, making it easier for the mining company to manage water risks as part of the business strategy with innovations that allow it to evaluate, monitor and reduce the water footprint in its operations, but that in turn link the

entire chain in their business model: partners, suppliers, collaborators and clients/beneficiaries with the reduction of the impacts they generate on water resources and generating spaces for collective management.

- Homologation and validation of public information such as that of the [ANA's Water Observatory](#), [SENAMHI's Hydrometeorological Data](#), among others.

1.2 Environment and Sustainability



The main challenge of the expansion of mining activity lies in the level of sustainability that can be achieved. This is essentially based on the efficient use of natural resources, as well as on its environmental footprint. As a result of the absence of environmental awareness and regulation, the Peru of the past left us with more than 8,000 mining environmental liabilities (most of which have no identifiable responsible parties), of which only around 1,000 are in the process of remediation.

Challenge 1: How to reduce, treat, take advantage of and/or improve the disposal, use and reuse of tailings and/or waste rock dumps and/or environmental liabilities?

Tailings are the main waste to be managed due to their high toxicity and large volumes, generating a perception of high negative impact when stored. Likewise, mine waste is the sterile material or low-grade mineral obtained as a result of the work done to obtain the mineral. In both cases, a system of permanent evaluation of associated risks is required.

Environmental liabilities are those facilities, effluents, emissions, remains or waste deposits produced by abandoned or inactive mining operations, which constitute a permanent and potential risk to the health of the population, the surrounding ecosystem and property ([Law 28271, Law that regulates the environmental liabilities of mining activity](#)). These liabilities are grouped in about 751 ex-Mining Units (exUM). However, for the time being there is no update of their specific characteristics nor a realistic estimate of the resources needed for their remediation ([IDB, 2021](#)).

Mining companies and allies are looking for technologies that consider one or more elements of value in their proposal.

Elements of value:

- Solutions aligned with international standards such as the Global
- Industry Standard on Tailings Management (GISTM), among others.
- Regarding tailings disposal, solutions that ensure the capacity of the tailing's dams, as well as their safety, with a focus on the structure. There is an opportunity for improvement in the incorporation of guides.
- Promote change in the unfavorable perception of tailings for alternative and safe uses.

- Solutions with a circular economy approach: i) revaluation (profitable businesses that allow the recovery of economic value) and ii) zero waste (maximum use of the concentrate).
- Opportunity to consider in the proposed solutions, State tools such as
- Tax Liabilities.
- Be clear about the advantages and disadvantages of the proposed use or reuse, considering, among others, its chemical stability (immobilization of contained metals).

Challenge 2: How to implement technologies in operations to become a carbon neutral activity?

Mining is a key sector in the global agenda for sustainable development and climate change; but not only through its role as a supplier of minerals and metals, so necessary for the generation of clean technologies; but also, as an agent of change capable of incorporating new technologies that reduce the carbon footprint and/or generate a positive footprint allowing it to be a carbon neutral activity.

Some energy alternatives that are being worked on are wind energy, solar energy, and biodiesel; likewise, green hydrogen is postulated as one of the pillars in the energy transition. However, carbon footprint reduction alternatives with economic/technical feasibility are still required.

Mining companies and allies are looking for technologies that consider one or more elements of value in their proposal:

Elements of value:

- Technologies that not only reduce the footprint, but are cost-efficient (considering energy storage, access to the mine site, as well as environmental conditions).
- Long-term approach including alternative uses of rehabilitated areas and considering a reduction of energy costs in post-closure activities.
- Solutions that consider the value chain (focus on suppliers).
- Consider in the solution continuous improvement processes in the adequate management of energy and in the reduction of the carbon footprint, such as those linked to ISO 50001.
- Efficient measurement or quantification of the carbon footprint as a key
- element to measure improvement and generate a positive impact on the sector's reputation.
- Synergy with other sectors or projects (e.g., reforestation, reducing the impact of illegal mining).

Challenge 3: How to incorporate into mine closure technologies that facilitate efficiency in mine closure processes?

Mining activity is not perennial, but has a life time; this requires mining companies to establish a plan so that, once the activity is over, conditions are

equal or better than before the activity. Thus, mine closure can be defined as the set of activities to be implemented throughout the life cycle of the mine in order to meet specific environmental criteria and achieve the desired social objectives after the mining stage. Mine closure is a progressive process that starts at the earliest stage of the project with the conceptual design and ends only when the specific closure objectives have been permanently achieved. There are four scenarios: (i) temporary closure, where a detailed care and maintenance plan needs to be developed, considering the possibility of future operations at the site; (ii) progressive closure, occurs concurrently with the operation stage of a mine, when a component or part of a component of the mining activity is no longer useful and activities such as dismantling, demolition, landform reestablishment, and/or revegetation are required; iii) final closure, when as a result of the depletion of economic mineral resources, mining and processing operations cease, requiring activities such as dismantling, demolition, in-situ studies for final disposal and/or salvage of materials, physical, geochemical and hydrological stabilization, landform restoration, revegetation, among others; and iv) post-closure, where the owner is responsible for the care and maintenance of the site for a minimum period of five years after closure ([MINEM, 2006](#)).

Mining companies and allies are looking for technologies that consider one or more elements of value in their proposal.

Elements of value:

- Knowledge is still lacking for effective closures to allow future use and/or recovery of habitats based on metallurgical research.
- Technologies that help the total recovery of the areas used during the operation, ensuring the sustainability of the closure activities over time.
- Technologies and/or solutions that incorporate the valorization of open pit closure costs, as well as acid water management.
- Cost-efficient technologies in the different activities required according to the type of closure.
- Solutions that take into account the visual impact.
- Covering technologies for the closure of mining components.
- Technologies/solutions that deepen the water-soil relationship for closure.

Challenge 4: How to incorporate models that generate shared value in mine closure?

Mining works, at the end, must restore the environment almost as it was previously. The recovery of vegetation and/or geochemical stabilization in tailings deposit areas is slow and, in turn, there is a high dependence of the communities around the mine on the success of closure.

In addition to the environmental and reclamation approach, today it is unthinkable not to include adding value to the community in the closure strategy. Prior to the removal of facilities, it is necessary to verify whether the community will need some of them. It is necessary to think of the best uses for these facilities to generate new activities. It is no longer possible to think of closure at the end of the life cycle of the operation, but rather closure plans

must be associated with the life of mine (LOM) and be progressive, so the data generation tools implemented must allow projecting the influence of mine closure on the environment and consider the long term.

Mining companies, State actors seek models/mechanisms and/or systems that consider one or more elements of value in their proposal.

Elements of value:

- Community involvement (communal companies / local actors) in land use planning, as well as in the generation of business models.
- Digitalization of water: information technologies that value open data in a transparent manner with a focus on generating trust.
- Solutions that consider visual impact.
- Solutions for temporary/progressive/end/post-closure.
- Solutions that promote the development of economic activities such as tourism, or others.
- Solutions that consider the impacts that already closed mines are having.
- Opportunity to adopt experiences from other countries considering the specific context of the ecosystem (climate: abundant rainfall, moorlands, etc.).
- Nature-based solutions, as well as revaluation of ancestral solutions such as wetlands, among others.

Challenge 5: How to generate shared value through the inclusion of economic, social, environmental and/or information and knowledge infrastructure?

Infrastructure is a key element for development, essential for improving people's quality of life, as well as for facilitating their inclusion in societies. Although a definition linked to tangible or capital goods is often used, in a broad sense infrastructure can be defined as the physical and organizational structures, networks or systems necessary for the proper functioning of a society and its economy.

The incorporation of economic, social, environmental and/or information and knowledge infrastructure generate an opportunity for inclusion for communities (sometimes located in remote areas), as well as strengthening the community-mining company relationship through the generation of shared value.

Mining companies and Government actors are looking for models/mechanisms and/or systems that consider one or more value elements in their proposal.

Elements of value:

- Infrastructure that facilitates the digital inclusion of communities and the impact this has on health, education, among others.

- Solutions to meet the demand for transportation of minerals and people considering the overloading of the existing road infrastructure.
- Future workforce.
- Development of the local value chain.
- Territorial approach.
- Digitalization of water: information technologies that make open data available in a transparent manner with a focus on trust generation.

1.3 Mining 4.0



The fourth industrial revolution is already a challenge that cannot be postponed in the mining sector and the current situation makes it even more urgent. Technologies such as the Internet of Things, Artificial Intelligence, virtual reality, robotization, Cloud, Big Data, cybersecurity, 3D printing, among others, are applicable to every stage of the mining business, from exploration to the closing of operations. Their applicability not only increases productivity, but also contributes to better environmental and social performance.

Challenge 1: How to improve productivity and efficiency in operations by leveraging 4.0 technologies and facilitating their adoption?

Increased productivity, reduced time and costs in operations, increased recovery in plant processes, are expected results that enable an opportunity for process automation, development of sensors, use of AI, among other 4.0 technologies. This requires the identification of processes or critical elements for their implementation. Likewise, to maximize the benefit, it is essential to manage the process of adaptation and use of these technologies by the employee.

Mining companies are looking for technologies that consider one or more elements of value in their proposal:

Elements of value:

- Simplicity in the use of technologies that facilitate change management considering the digital divide of potential operators, collaborators and/or decision makers.
- Solutions that consider not only the implementation of technology but also its integration with other technologies to maximize value.
- Solutions that have as a pillar the adoption of the technology, through long-term support and/or methodology (not only sale of instruments).
- Solutions that incorporate measurements that allow to show clear benefits, with an adequate management of reports and indicators.
- Opportunity in the application of advanced analytical models for process optimization (existence of extensive data, but with a difference in format).

- Cost-efficient solutions that consider the capture, transmission, and use of data for interoperability.
- Technologies accessible to small and medium-sized companies.
- Adaptation to the operating conditions in Peruvian mines (geography, climate, value chain, etc.).
- Technologies that involve suppliers in the value chain.
- Technologies that retake the basic principles of mining cycle and its unitary operations. For example: track maintenance, SAG grinding.
- Technologies that consider the limitations of mine connectivity infrastructure.
- Self-financing in the implementation of solutions.

Challenge 2: How to increase personnel safety through digitization throughout the entire operation?

Mining activities require permanent protection of workers to minimize the risk of accidents and to ensure that they can work safely. Safety is transversal to the entire operation and begins with the change of shifts.

Mining companies are looking for technologies that consider one or more elements of value in their proposal.

Elements of value:

- Solutions that consider a paradigm shift in workers regarding the benefit of the use of technological solutions with respect to their safety. As well as the simplicity in its use.
- Solutions that consider not only the implementation of the technology but also its integration with other technologies to maximize value.
- Opportunity in the application of advanced analytics models (extensive data but with a difference in formats).
- Technologies accessible to small and medium-sized companies.
- Adaptation to operating conditions in Peruvian mines (geography, climate, value chain, etc.).
- Technologies that involve suppliers in the value chain.
- Technologies that reduce exposure in high-risk jobs, as well as in those with greater recurrence.
- Technologies that quickly and efficiently report work-related incidents.
- Technologies for early warning and prevention of potential incidents.
- Technologies that reduce contact between vehicles.

- Predict operator and staff fatigue.
- Maximize the impact of training on staff.
- Detect and alert anomalous situations.

Challenge 3: How to incorporate technologies that guarantee cybersecurity in the mining company in the face of the use of 4.0 technologies?

Traditionally, security has focused on protecting people, a key player in the mining operation. However, as a result of digital transformation and the inclusion of technologies based on Industry 4.0, security requires a new approach that includes systems, validation and data protection.

Mining companies are looking for technologies that consider one or more elements of value in their proposition

Elements of value:

- Consider remote work in information management.
- Technologies that ensure information protection.
- Solutions that incorporate gap and/or weakness analysis (e.g., Ethical hacking).
- Solutions that consider a paradigm shift in workers regarding the benefit of using technological solutions with respect to their security. As well as the simplicity in their use.
- Solutions that consider not only the implementation of technology but also its integration with other technologies to maximize value.
- Technologies accessible to small and medium-sized companies.
- Adaptation to the operating conditions in mines in Peru (geography, climate, value chain, connectivity, etc.).
- Solutions that consider regulations such as, for example, the Personal Data Protection Law.

For further reference on supporting documents for the thematic areas visit the website: www.perumin.com/en/hub.

Annex 2. Cover Letter

Cover Letter⁷

Gentlemen
PERUMIN Hub
Present.

I, *(indicate first and last names)*

.....

....., as (position within the institution I represent: legal representative, director or others as applicable)

..... of the
(indicate the name of the company/entity/department or whichever is applicable)

....., am pleased to communicate my intention to participate in the PERUMIN Hub 2022 open innovation program competition.

I declare that I am aware of the provisions of these terms and conditions and that all the information presented in the proposal of the institution/entity I represent is strictly in accordance with the truth.

Name and Surname
ID/Passport
E-mail address
Cell Phone

⁷ The letter may be signed digitally or physically. In the case of companies/NGOs/associations it must be signed by the legal representative and in the case of universities by the highest authority of the instance/area/department being submitted.

Annex 3. Letter of Collaboration

Collaboration Commitment Letter⁸

Gentlemen
PERUMIN Hub
Present.

I, *(indicate first and last names)*
.....
....., as (position within the institution you represent: legal representative, director or others as applicable)
..... of the
(indicate the name of the company/entity/department or the corresponding one), am pleased to communicate my commitment to collaborate, as a strategic partner, in the proposal *(indicate the name of the project submitted to the competition)*, submitted by *(indicate name of the company/institution applying)* in the framework of the PERUMIN Hub 2022 open innovation program competition.

I declare that I am aware of the provisions of these terms and conditions as that all the information presented in the proposal, of which I am a part, is strictly in accordance with the truth.

Name and Surname
ID/Passport
E-mail address
Cell Phone

⁸ The letter may be signed digitally or physically. In the case of companies/NGOs/associations it must be signed by the legal representative and in the case of universities by the highest authority of the instance/area/department being submitted.