PERUMIN 37 CONVENCIÓN MINERA

INSTITUTO DE INGENIEROS DE MINAS DEL PERÚ

MINERÍA DEL FUTURO

INNOVATION IN WATER RESOURCES MANAGEMENT

Jose N. De Piérola C.

Honorary Professor at Universidad Nacional Agraria “La Molina”

President of APIHA

Advisor and consultant in Water Resources Management

JUNTOS POR MÁS OPORTUNIDADES Y BIENESTAR PARA TODOS


La Edición 175 de la Revista Rumbo Minero pages 182 - 183 of 586

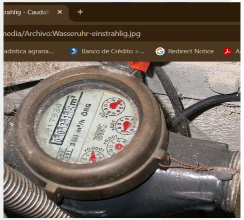
Tecnologías de tratamiento, recuperación de agua y plantas desalinizadoras

AGUA: OPTIMIZACIÓN DEL PRINCIPAL INSUMO EN MINERÍA

El agua constituye el recurso más utilizado en una operación minera, ya que interviene en prácticamente todas las etapas del procesamiento del mineral. En la actualidad, su uso adquiere una importancia estratégica, pues la prioridad de las empresas de este sector es garantizar su preservación mediante una gestión eficiente y responsable.

EVOLUTION OF WATER GOVERNANCE IN PERUVIAN MINING SECTOR

Milestones in the transformation



🟤 1990 – Environmental Code and Natural Resources (D.L. 613)

- First legal framework acknowledging environmental management in mining, though without specific provisions for water.
- Introduces the concept of Environmental Impact Assessment (EIA), but lacks of continuous water monitoring.
- Water measurements were basic and periodic, using mechanical and invasive instruments.
- Monitoring was manual, with data stored in written records and physical archives.

🟠 1993–1997 – Economic Liberalization and Foreign Investment

- The country opens to foreign investment, bringing in new mining technologies and international standards.
- Introduction of hydrological/hydrogeological modeling, along with the concept of water balance in mining operations.

🟡 2008 – Creation of the Ministry of Environment (MINAM) – D.L. 1013 (May 2008)

- Strengthens environmental institutional capacity and oversight.
- Water quality monitoring becomes a formal component of Environmental Impact Assessments.
- Adoption of electromagnetic and ultrasonic measurement systems begins.

🟢 2008 – Establishment of the National Water Authority (ANA) – D.L. 997 (March 2008)

- Introduces the concept of Integrated Water Resources Management (IWRM).
- Basin-level management is initiated, along with the development of monitoring instruments.
- Online SCADA systems are introduced for real-time control, supported by improved Wi-Fi communication, data storage, and fiber optic networks.

EVOLUTION OF WATER GOVERNANCE IN PERUVIAN MINING SECTOR

Milestone of the transformation

🔵 2012 – Establishment of SENACE (Law No. 29968, December)

• Formalization of Environmental Impact Assessment (EIA) procedures, incorporating hydrological balance modeling, source water analysis, and discharge control protocols.
• Automation begins in water production (source abstraction) and distribution (plant-level operations).
• Digitalization of water management systems, covering quality and quantity metrics.
• Online integration of water/energy balances enhances operational efficiency and reporting.

🟣 2012 to Present – Digitalization and Water Stewardship Integration

• Leading mining operations—Southern Peru, Las Bambas, Antamina, Cerro Verde, and Quellaveco—deploy real-time monitoring systems, including sensors, SCADA platforms, and cloud-based data environments.
• Introduction of the ICMM's Water Stewardship Maturity Framework, emphasizing internal and external governance, transparency, and shared value creation across stakeholders.
• Inclusion of the territorial approach in the mining development strategy.


Fuerza Minera · 7 oct 2023

Perú: Las Bambas implementa sistema de gestión inteligente del agua

Minera Las Bambas ha implementado un Sistema de Automatización del Balance de Aguas que redefine la gestión y el monitoreo del recurso hídrico en sus operaciones.

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EVOLUTION OF THE GLOBAL WATER MANAGEMENT VISION

Incorporation of social and environmental components

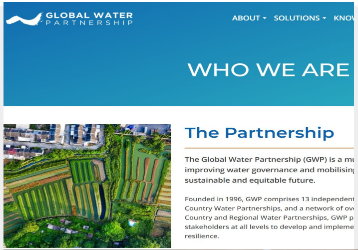
1992 – Rio Summit
The concept of Integrated Water Resources Management (IWRM) is formally introduced as a global framework for sustainable water governance.

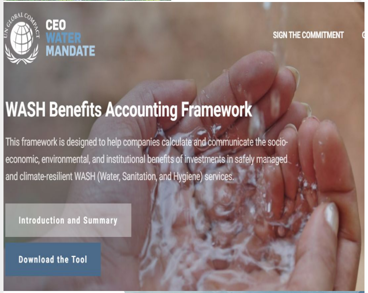
1996 – Creation of the Global Water Partnership (GWP)
Established to promote and operationalize IWRM across countries and sectors, fostering collaboration among governments, civil society, and technical institutions.

2007 – Launch of the UN CEO Water Mandate
Initiated by the United Nations to engage the private sector in responsible water management, emphasizing transparency, efficiency, and stakeholder engagement.

2008 – Establishment of the Alliance for Water Stewardship (AWS)
Created to develop and promote a global standard for Water Stewardship, integrating environmental, social, and economic dimensions.

2010 – Formal Emergence of the Water Stewardship Concept
Defined as: the responsible use of water that is socially equitable, environmentally sustainable, and economically beneficial. Its operational framework is based on the watershed level, recognizing water as a shared resource requiring collaborative governance.





Mining and water around the world.

- Decarbonization process is under way with variations on mining standards.
- There are an expected increase in metals and critical minerals demand over the next few decades, until 2050
- New trends are emerging regarding water use in mining.
- Key concepts include Water stewardship, circular economy, and desalination.
- The social aspect of mining activities involves engagement with communities and stakeholders.

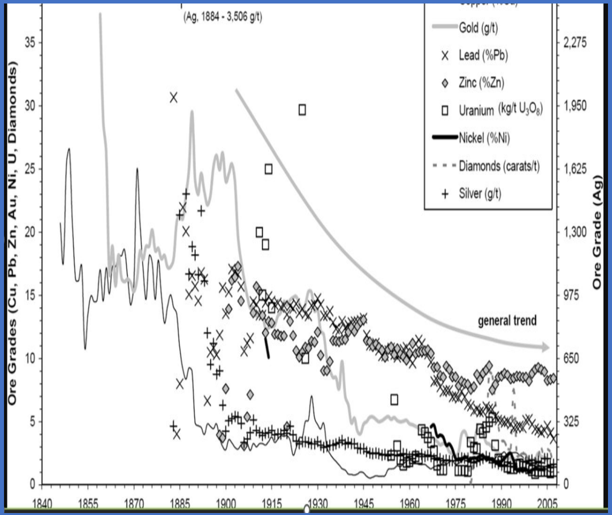
OUTLOOKS TOWARDS 2030 AND 2050.

Outlooks towards 2030 and 2050.

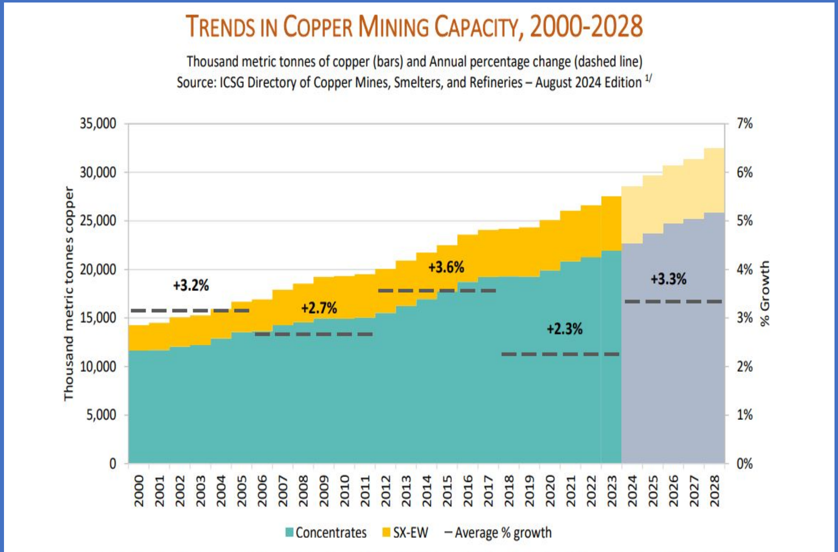
Due to declining ore grades, it will be necessary to process larger volumes of mineral to produce the same amount of copper, iron, gold, and other metals.

Copper demand is increasing, driven by the global transition away from fossil energy sources.

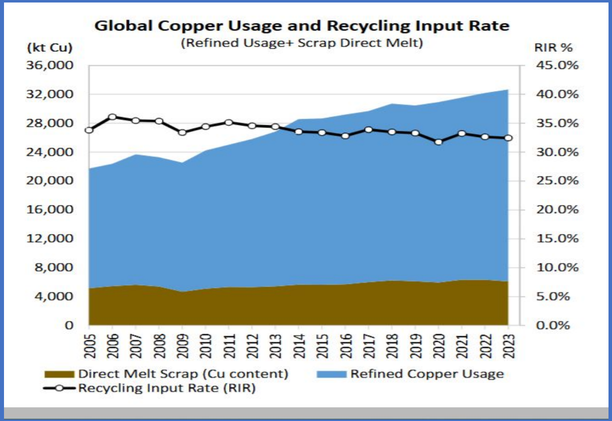
Meanwhile, recycling rates of Copper have remained relatively stable over the past several years.



Technological assessments on recent fine and coarse particle flotation systems developments. Ahmad Hassanzadeh [a b], Mehdi Safari. Minerals Engineering vol 180, April 2022.

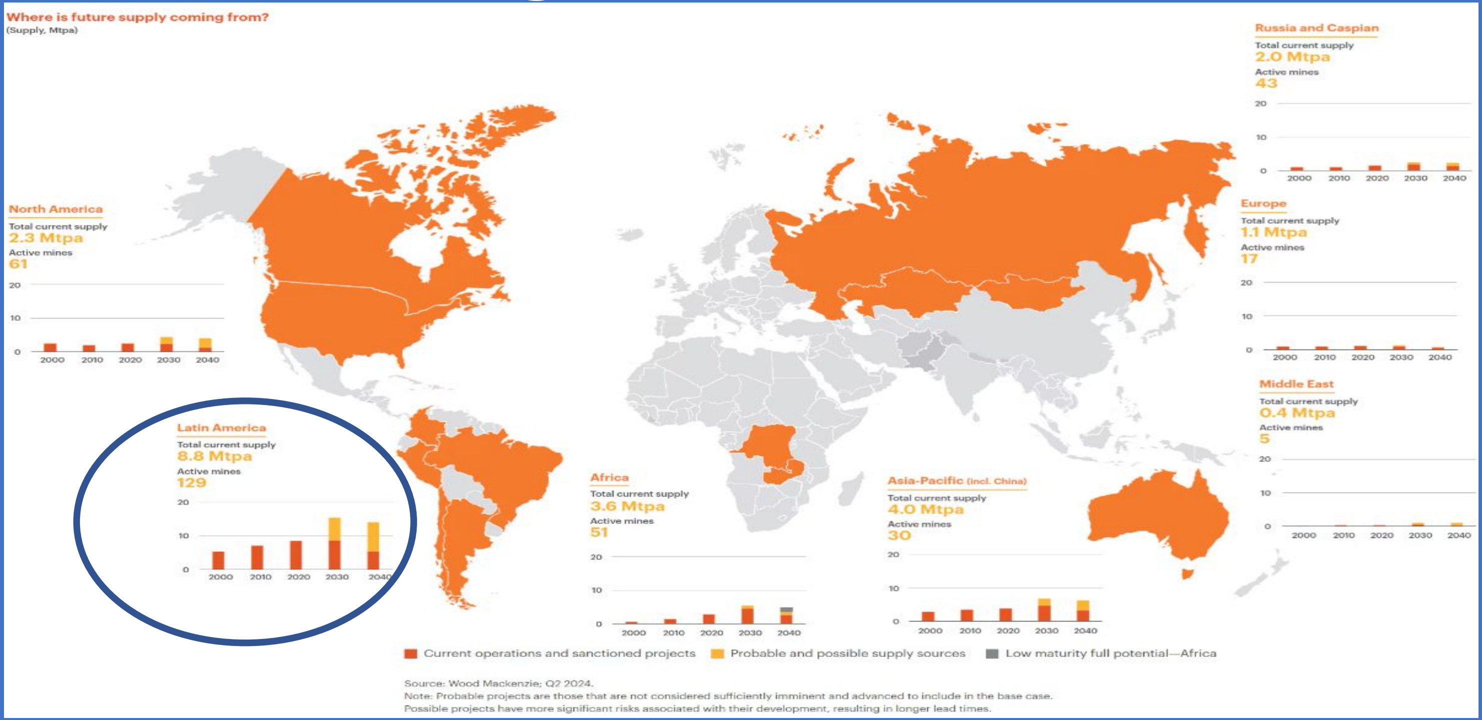


Copper mining capacity is estimated to reach 32.4 million tonnes by 2028, with 20% coming from SX-EW and 80% from concentrates. This will be 18% higher than the global capacity of 27.5 million tonnes recorded in 2023. Growth in copper mine capacity is expected to average 3.3% per year going forward as



1. *Technological assessments on recent fine and coarse particle flotation systems developments.* Ahmad Hassanzadeh [a b], Mehdi Safari. Minerals Engineering vol 180, April 2022.

Current and future scenario: Cooper mining around the



https://www.bhp.com/-/media/project/bhp1ip/bhp-com-en/images/general/copperbhpinsights/slide6.png

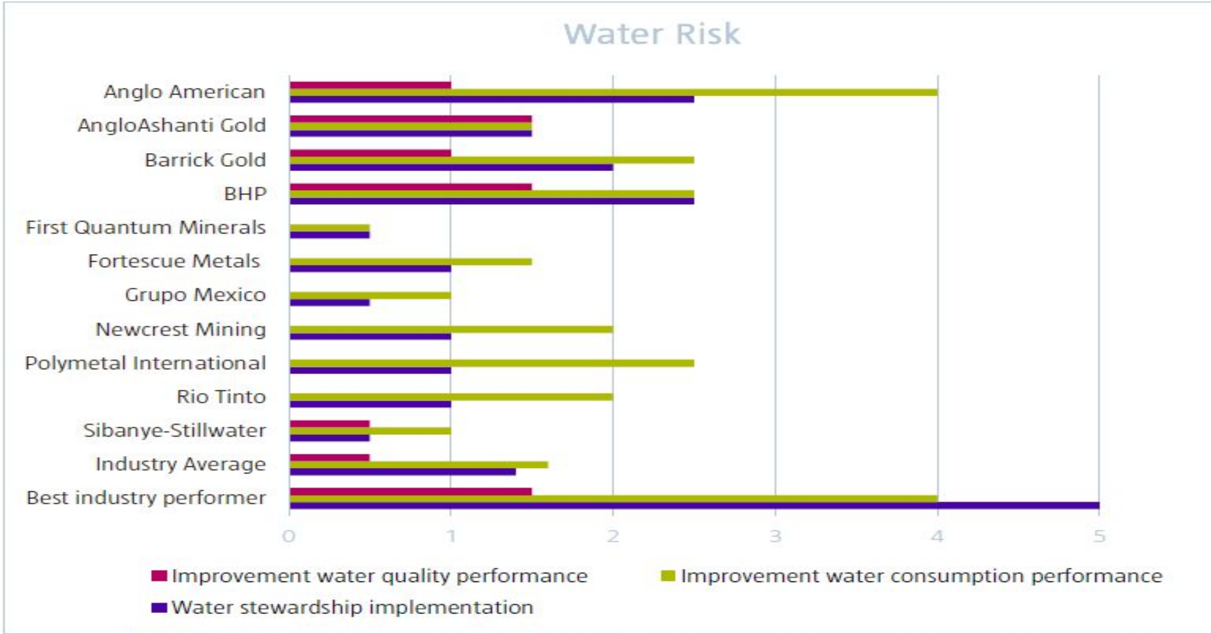


Figure 12 | Water Risk Baseline Overview Relevant RMI scores

Ref. Robeco Mining Report, 2020

Water Risk Filter

WATER RISK FILTER

TECHNOLOGICAL INNOVATION AND ITS IMPACT.

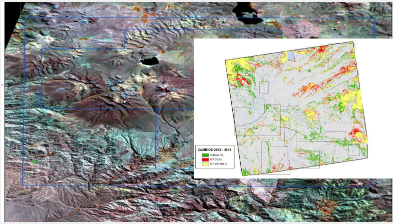
• **Deployment of integrated digital control systems** covering water quality and quantity online across sources, operational distribution, tailings storage facilities (TSFs), and recovered water flows.

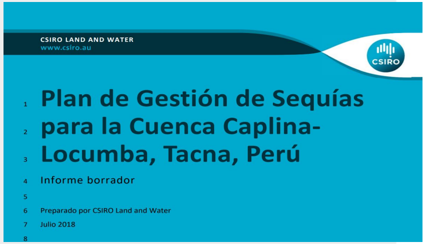
• **Introduction of new techniques in the process** like Coarse Particle Flotation (CFP) to reduce water consumption and improve disposal of tailings.

• **Advanced remote sensing technologies**—including LiDAR imaging, drones, radar, and green laser—used for real-time monitoring of water and tailings volumes, supported by automated warning systems and continuous surveillance via Interferometric Synthetic Aperture Radar (InSAR).

• **Satellite imagery (WorldView/SPOT) and GIS platforms** applied to territorial management, integrating physical-geological features, water sources, vegetation, community dynamics, and ecosystem mapping.

• Governance, strategic planning, risk management, and performance tracking (KPIs and control targets) are now embedded as core components of water stewardship in mining operations.

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Plan de Gestión de Sequías para la Cuenca Caplina-Locumba, Tacna, Perú

Informe borrador

Preparado por CSIRO Land and Water
Julio 2018

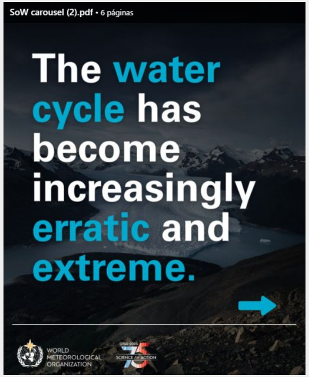
Challenges in innovation I.

• **Drastically reduce freshwater** in mining operations by transitioning to filtered or dry tailings, thereby eliminating long-term risks associated with Tailings Storage Facilities (TSFs). Water reuse and zero-effluent systems will serve as core management tools.

•**Develop climate and hydrological forecasting models** to anticipate droughts and extreme rainfall events, enabling timely deployment of control and mitigation measures under climate change scenarios.

• **Incorporate desalinated water**, targeting minimal O&M costs and low energy consumption (kWh/m³), alongside the industrial utilization of brine byproducts.

• **Significantly narrow the technological efficiency gap** in water uses between mining operations and surrounding communities, aiming for sustainable, basin-level water use.



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Challenges in innovation II

•**Innovation has two Dimensions**: development of technology (hardware and software), and management of new technologies, i.e., how to integrate them into the production process and ensure their long-term sustainability, and then how to change again.

• **Consolidate research lines on socio-environmental topics** of mutual interest with local water users, including:

Technification of small-scale agriculture, Deployment of green infrastructure, Local water reuse systems, and artificial aquifer recharge.

operación minera líder en la era digital, aprovechando las tecnologías más avanzadas y basadas en datos para tomar decisiones estratégicas sostenibles que beneficien tanto a la empresa como al medio ambiente y la comunidad.

Fuente: Horizonte Minero

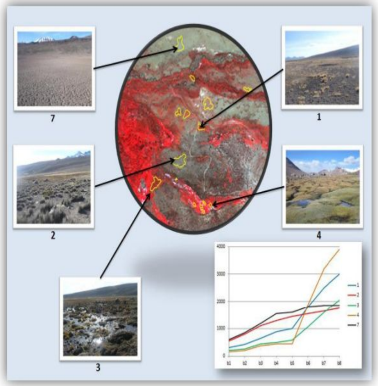

Figura 36. Generación de sitios de muestreo, y desarrollo de firmas espectrales de la imagen WorldView 2 (2012)

Gracias….!!