



CHALLENGE TITLE

Mass Movement of Minerals in Open Pits and Underground Mining.

CHALLENGE DESCRIPTION

Material movement in complex environments such as deep open pits and underground mining presents technical, logistical, and environmental challenges that limit operational efficiency, safety, and sustainability. Current technologies face constraints due to steep slopes, confined spaces, limited ventilation, and demanding geomechanical conditions. This challenge seeks to promote the development and validation of adaptive technologies for material transport in these environments, prioritizing solutions that enhance operational safety, energy efficiency, and integration with ventilation, sorting, and mining automation systems.

GENERAL OBJECTIVE

Contribute to the piloting and validation of adaptive technological solutions for material movement in open pits and underground mining, improving safety, energy efficiency, and operational integration in complex environments.

SPECIFIC OBJECTIVES

1. Co-develop adaptive transport technologies for environments with high geomechanical and operational complexity.
2. Design comparative models of technical, energy, and safety performance against conventional systems.
3. Execute pilots in deep open pits and underground tunnels to validate efficiency, robustness, and compatibility with existing systems.



4. Generate technical guidelines and protocols to integrate solutions with ventilation, sorting, automation, and environmental management systems.

EXPECTED RESULTS

- Technical reports with validation results in open pits and underground mining.
- Comparative indicators of energy efficiency, safety, and performance versus conventional technologies.
- Demonstration pilots of adaptive technologies in operational environments.
- Technical guideline document for industrial adoption.

SCOPE

Includes:

- Material transport technologies in open pits and underground mining with TRL ≥ 4 .
- Demonstrations in controlled relevant environments, semi-industrial and operational piloting and validation.
- Evaluation of technical, energy, environmental, and safety performance.
- Studies on integration with ventilation, automation, and mining operation systems.

Does not include:

- Proof-of-concept and/or laboratory-scale tests with TRL < 4 .
- Design, construction, or operation of a full-scale industrial manufacturing plant.
- Solutions that pose additional risks to worker, equipment, or environmental safety.



- Technologies that increase consumption of strategic resources such as water or energy.
- Interventions that negatively interfere with the continuity of the production process.

KEY PERFORMANCE INDICATORS (KPIs)

1. Reduction in logistical cost (%) per ton transported.
2. Reduction in energy consumption (%) per ton transported.
3. Reduction in GHG and particulate matter emissions (%) compared to conventional baseline.
4. Average recovery time after a failure.
5. Percentage of time the technology is operational versus total planned time.

DESIRABLE CONTRIBUTION TO ITL CAPACITY BUILDING

- Development of validation and technological certification protocols for material transport.
- Enablement of pilot infrastructure for testing in deep open pits and underground mining.
- Training and protocols for operation and maintenance associated with the transport system.