European Innovation Partnership on Raw Materials

Application for a Raw Materials Commitment

Fully automated mineral winning process/system including near-to-face processing and backfilling for deep metal mines

Acronym:
I²Mine-pilot

Links to the Strategic Implementation Plan:

- **I. Technology Pillar**
  - I.B Priority Area: Technologies for primary and secondary raw materials’ production
    - Action area n° I.3: Innovative extraction of raw materials
      - 1) Automated mining
    - Action area n° I.4: Processing and refining of raw materials
      - 1) Innovative and flexible processing

- **III. International Cooperation Pillar**
  - III. International Cooperation Pillar
    - Action area n° III.1: Technology
      - 1) Exploit synergies in R&D with regard to exploration, extraction and processing
      - 5) Dialogue with technologically advanced countries
    - Action area n° III.3: Health, Safety and Environment
      - 1) Establish and foster exchange of information with countries engaged in sustainable mining
    - Action area n° III.5: Investment activities
      - 1) Promote Europe as a continent with long mining traditions, developed mining education system and high environmental requirements

Objectives of the commitment:

Objective of the project is to establish a pilot installation of an integrated minerals extraction/processing process for deep metal mines which will base on developments of innovative methods, technologies, machines and equipment for mining at great depths. The development work is envisaged to be carried out mainly in the frame of I²Mine and I²Mine-2 as well as in the frame of the Swedish “Smart Mine of the Future” study. The installation should comprise (among other things):

- Systems for characterising resources in terms of geometallurgy and rock mechanics linked and fully utilised in production planning, mining and processing
• Autonomous, highly selective mineral extraction processes and machinery continuously exploiting deposits in greater depths
• New near-to-face pre-concentration and processing methods including fully automated backfilling based on very low content ore
• and more

**Description of the activities:**

When looking for new mineral resources mining operations will go deeper and deeper. It may create problems with rock stability and temperature, risks of structural collapse or rock and occurrence of seismic events. There will be a need for safer operations underground, less direct human activity in harsh working conditions. The solution is new extraction technology based on remote steering and sensing, wide use of IT and robotics use in mining operations. The next opportunity is integrating some processing operation in underground operation by using sensors and on line monitoring of quality extracted ore (run-of-mine ore) and separating metal low content ore before hoisting and processing. This separated barren rock can be used as backfill. The new solutions in hard advanced materials give opportunity to use special tools to break hard metal rock without using explosives. The whole spectrum of novel technologies should be supported by new solutions in mine infrastructure including modelling of technological operations, data transmission, communication, logistics and transport.

The foreseen installation will apply achievements obtained in the frame of the I²Mine and I²Mine-2 projects as well as from the Swedish “Smart Mine of the Future” studies:

• Integrated minerals extraction/processing process for deep metal mines
• Innovative methods, technologies, machines and equipment for mining at great depths
• Autonomous, highly selective mineral extraction processes and machinery continuously exploiting deposits in greater depths
• New near-to-face pre-concentration and processing methods including fully automated backfilling based on very low content ore
• Systems for characterising resources in terms of geometallurgy and rock mechanics linked and fully utilised in production planning, mining and processing
• High ore recovery mining processes and decreased ore dilution
• Systems for improvement of the fragmentation chain (“Mine to Mill chain”)
• Systems for fully automated mine process control
• New systems for rock mechanics and ground control at great depth under static and dynamic loading conditions as well as squeezing and seismic conditions
• Environmental management system applying the principle of metallurgical accounting
• Increase safety in mining operations by eliminating fatalities to zero/year, improving health and safety issues and work environment;
• Attractive workplace for an innovative, efficient and competitive mining culture based on lean mining by focusing on work environment, health and safety issues
• Training programmes and tools to ensure availability of skilled staff (expertise) in mining
• An attractive facility for demonstration and marketing the modern/future deep mine as a green, safe and attractive working place to decision makers, the society at large and students and researchers

The technological challenges of all developments are to make them fit for underground use in the expected harsh environment of below 1,500 m. The reliable stabilisation of the surrounding rock formations will be one of the biggest challenges in such depths.

**Description of the expected impacts:**
Technical impacts:
• Providing Europe with innovative, world-class technology for minerals exploitation in deep future mines
• Realising fully automated and online monitored mining and mineral processing operations
• Cross-sector collaboration providing for wide use of advanced materials, IT processes, embedded systems innovations, etc. assisting next generation equipment and tools

Economic impacts:
• Deeply located deposits can be mined and processed in eco-efficient and safe way
• Constant and stable supply of copper, silver and other metals for the European economy
• Achieving higher recoveries and less waste and dilution
• Improvement of self-sufficiency in some critical minerals and metals
• Improvement of resource efficiency in case of metals
• Strengthening the position of European equipment suppliers
• Strengthening international and interdisciplinary cooperation, both in the technical and socio-economical field

Environmental impacts:
• Less energy use, waste deployed underground (to a large extent)
• Processing technologies located underground
• Less pollutant emissions in and from the mine
• Further step towards the “invisible, zero-impact mine” concept
• Less land use for mining installations

Societal impacts:
• Improvement of the image of the mining industry
• Less problems with access to space in densely populated areas
• Mining becomes more attractive
• Mining will create more and better jobs and attract more young people to start a career in mining

**Expected innovation outcomes:**
New processes
New technologies

**Name of the coordinating organisation:**
Mineral Industry Research Organisation - MIRO

**Country:**
United Kingdom

**Entity profile:**
Private sector - SME

**Role within the commitment:**
Project management, communication, promotion, dissemination

**Other partners:**

**Name of partner:**
Partners from IMine consortium and Smart Mine of the Future partners

**Country:**
Europe

**Entity profile:**
Other

**Other:**
Partners from industry, SMEs, academia and research institutes

**Role within the commitment:**
Covering all necessary work items, commissioning equipment, adaptation of machinery and processes, preparation of pilot site, providing access to the site, etc.

**Name of partner:**
KGHM Polska Miedz S. A.
**Country:**
Poland
**Entity profile:**
Private sector - large company
**Role within the commitment:**
Providing underground space for testing and demonstrating achievements, contribution to development of feasible technical solutions for underground deep mining and infrastructure underground

**Name of partner:**
Luossavaara-Kirunavaara AB – LKAB
**Country:**
Sweden
**Entity profile:**
Private sector - large company
**Role within the commitment:**
Providing underground space for testing and demonstrating achievements, contribution to development of feasible technical solutions for underground deep mining and infrastructure underground

**Existing EU contribution:**
No

**Period to implement the commitment:**
Saturday, 1 July, 2017 to Thursday, 31 December, 2020