INTERMIN Final Review Meeting
Raw materials sector skills, gaps and emerging knowledge needs
Online, 23 September 2021

La Palma Research Centre

Work Package 2: Raw material skill gaps – future skills for the digital area and socially responsible mining

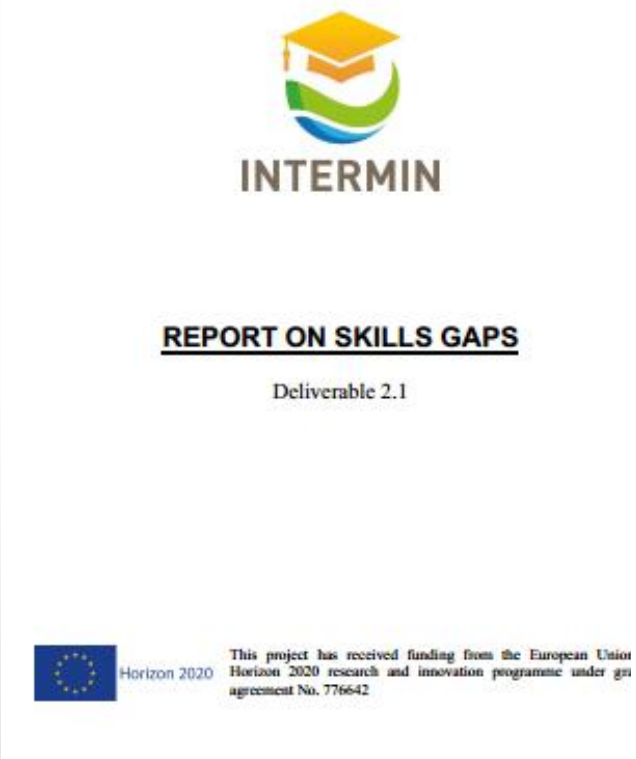
Marco Konrat Martins, **Luís Lopes**, Adrienn Cseko

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 776642

WP2 – Tasks and Deliverables

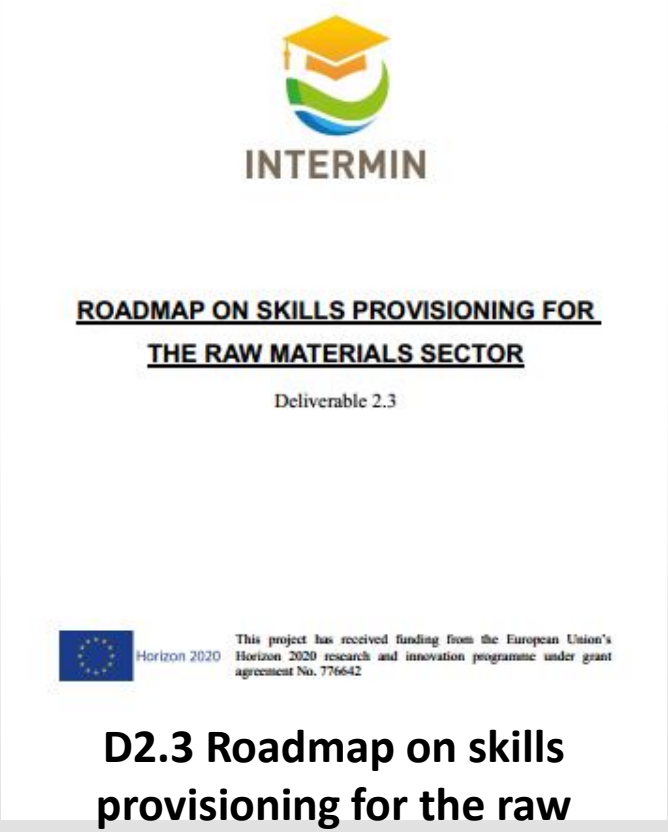
Task 2.1 - Assessment of employers' needs

Task 2.2 - Competency model for the raw materials sector



D2.1 Report on skills gaps (M18)

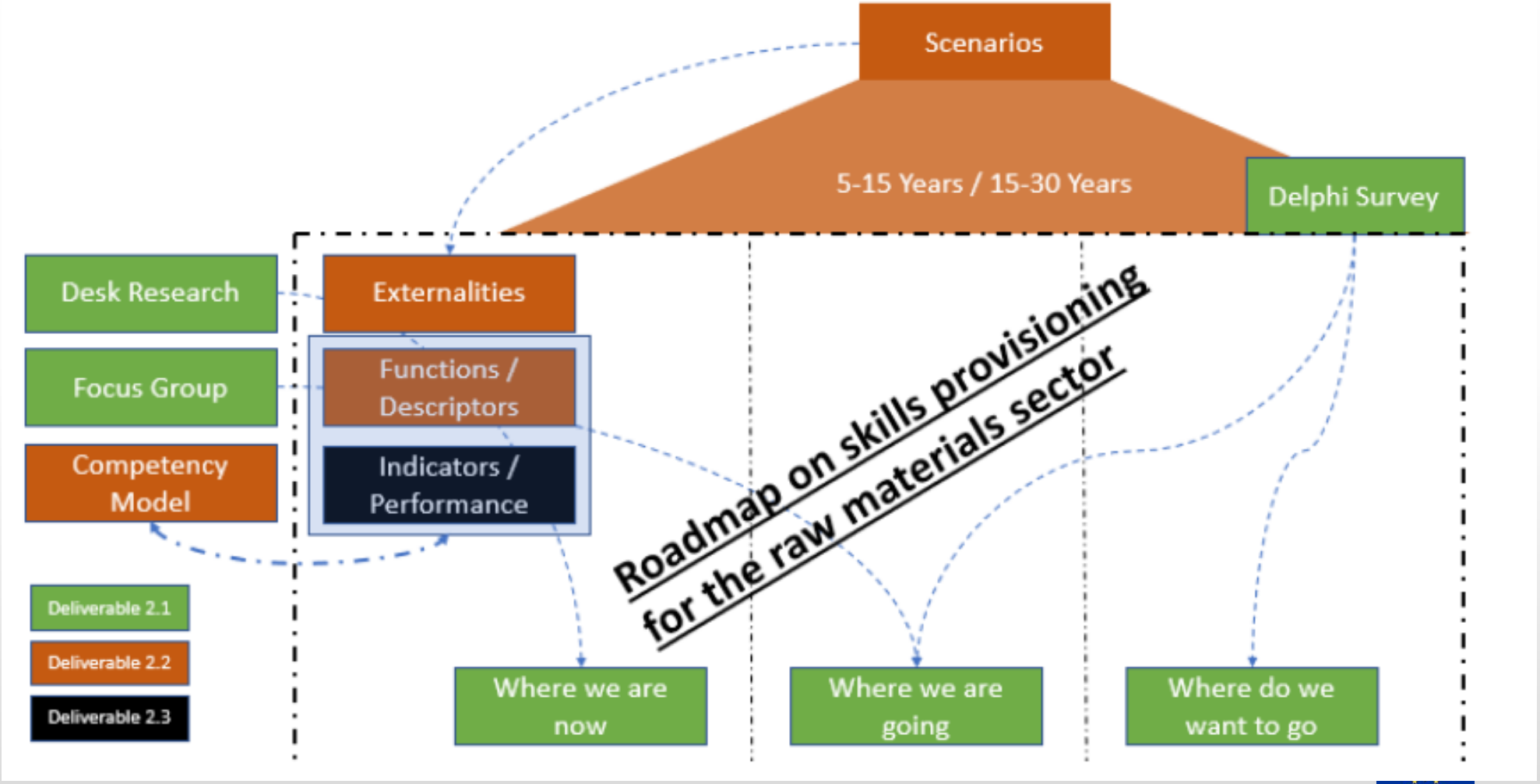
D2.2 Integrated competency model for employment across the raw materials sector (M18)



D2.3 Roadmap on skills provisioning for the raw materials sector (M20)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 776642

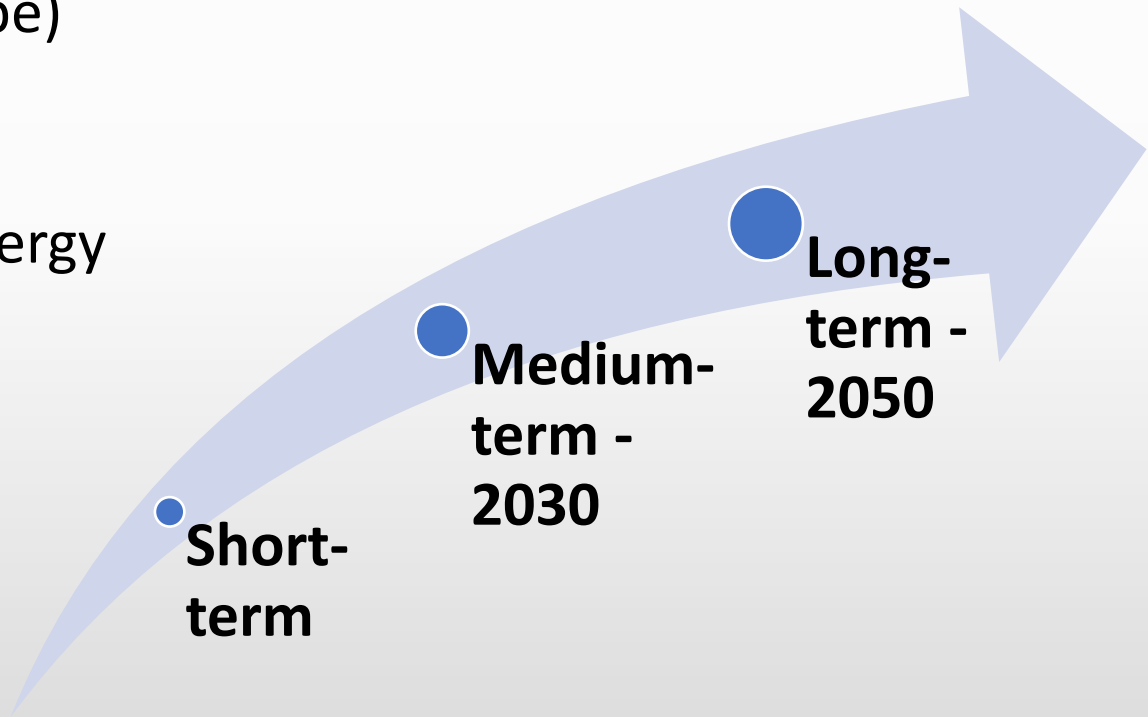
WP2 - Skill Gaps



This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 776642

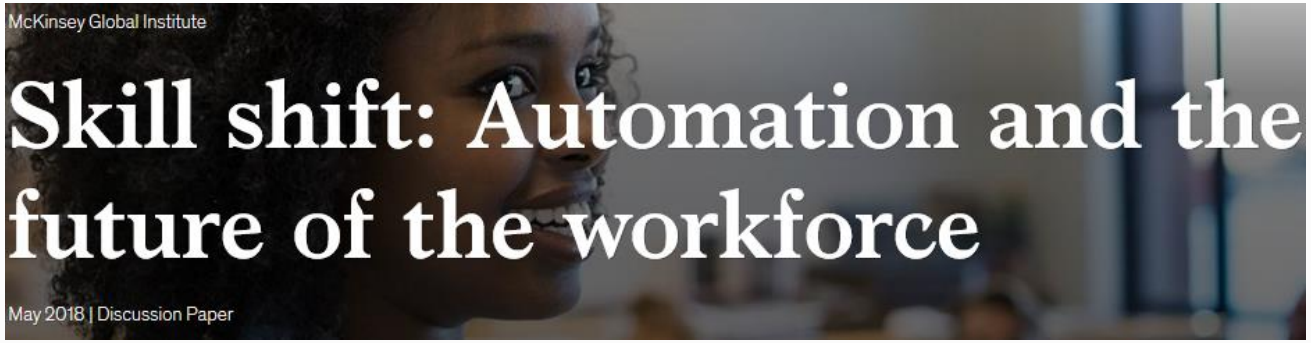
WP2 - Skill Gaps

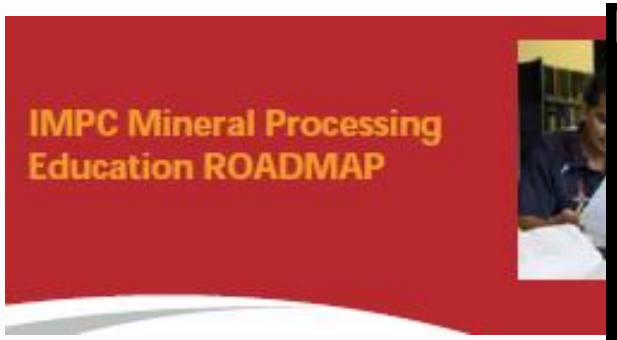
- **Short-term** (Next years, Horizon Europe)
  - Review of position papers/Desk research
- **Medium –term** (2030, Climate and energy framework)
  - Focus Groups
- **Long-term** (2050, Carbon neutrality)
  - Delphi survey



This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 776642

Many sectoral reports available..

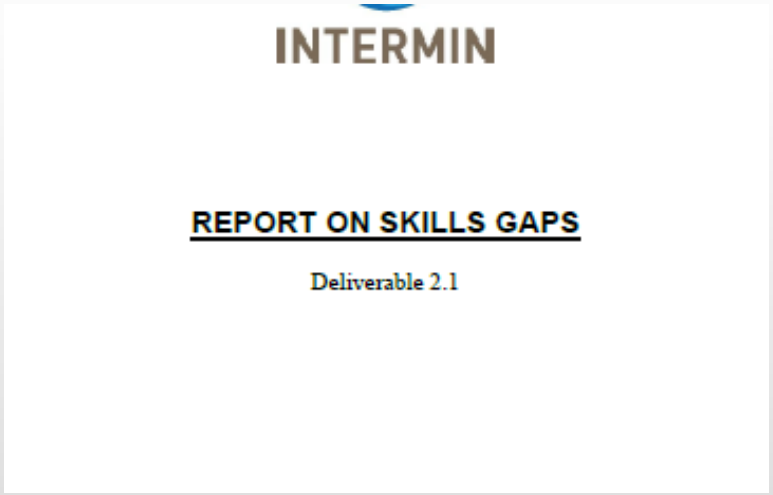


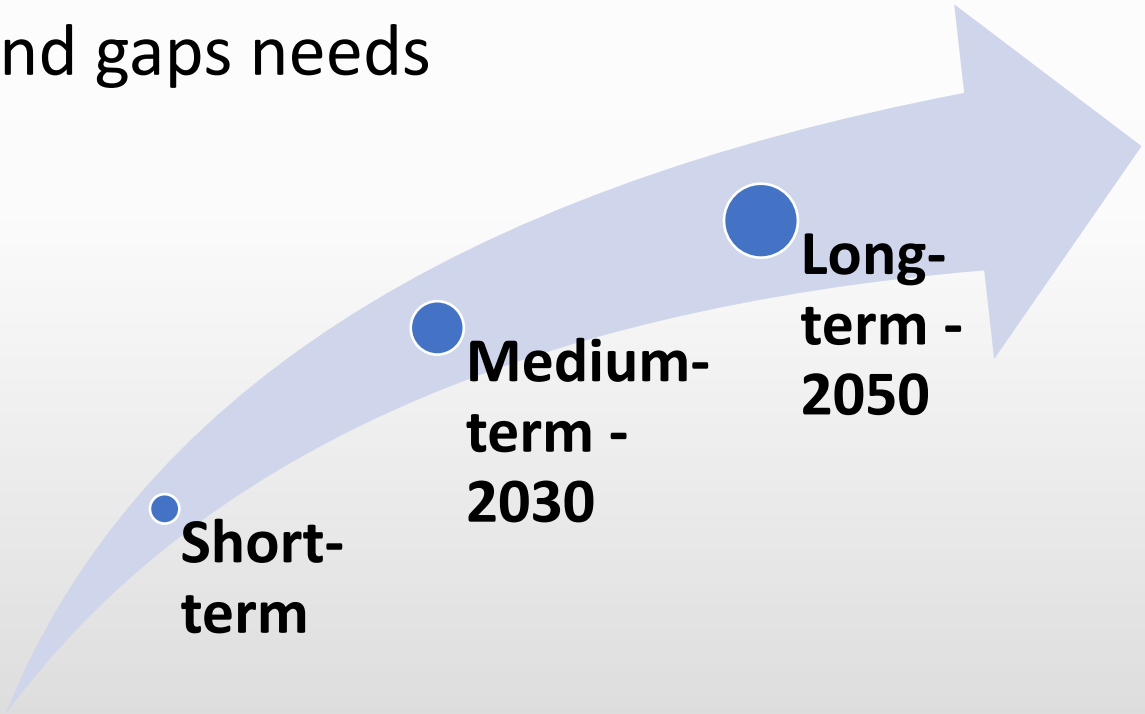


This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 776642

WP2 - Skill Gaps

- Current and future competences and gaps needs

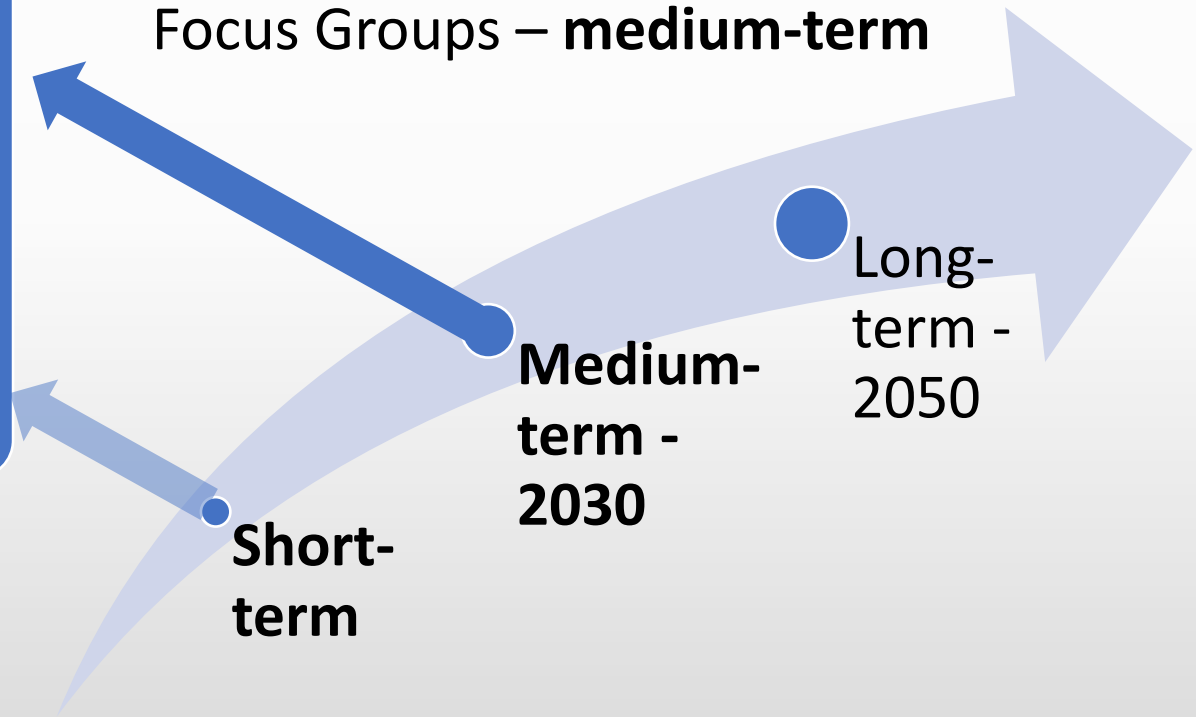




This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 776642

WP2 - Skill Gaps

- **Identification** of main trends and drivers of change – **short-term**
- **Extrapolation and exploration** through Focus Groups – **medium-term**



This project has received funding from the European Union’s Horizon 2020 research and innovation programme under Grant Agreement No 776642

Focus Group & Manifesto

Mining 4.0 Digital transformation

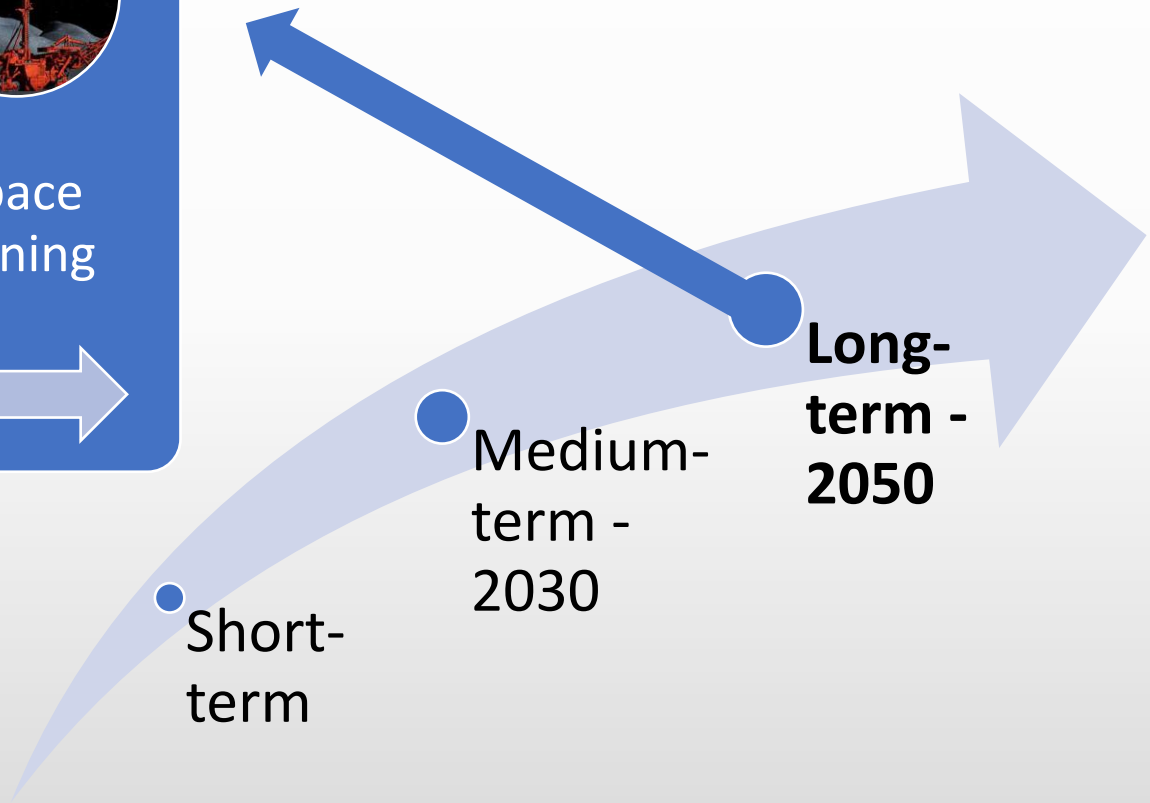
- Shift towards higher cognitive & complex problem solving skills;
- Knowledge in different components of the value chain;
- Initiatives for re-skilling & up-skilling, support mobility & rotation;
- Attract talents from other sectors;
- Increase collaboration with universities;

Social Skills

- Communication, leadership & training skills are expected to increase in demand;
- Responsible sourcing of minerals: skills related to mining rehabilitation and waste management;
- New branding/repositioning “Raw Materials Providers”;

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under Grant Agreement No 776642

WP2 - Skill Gaps

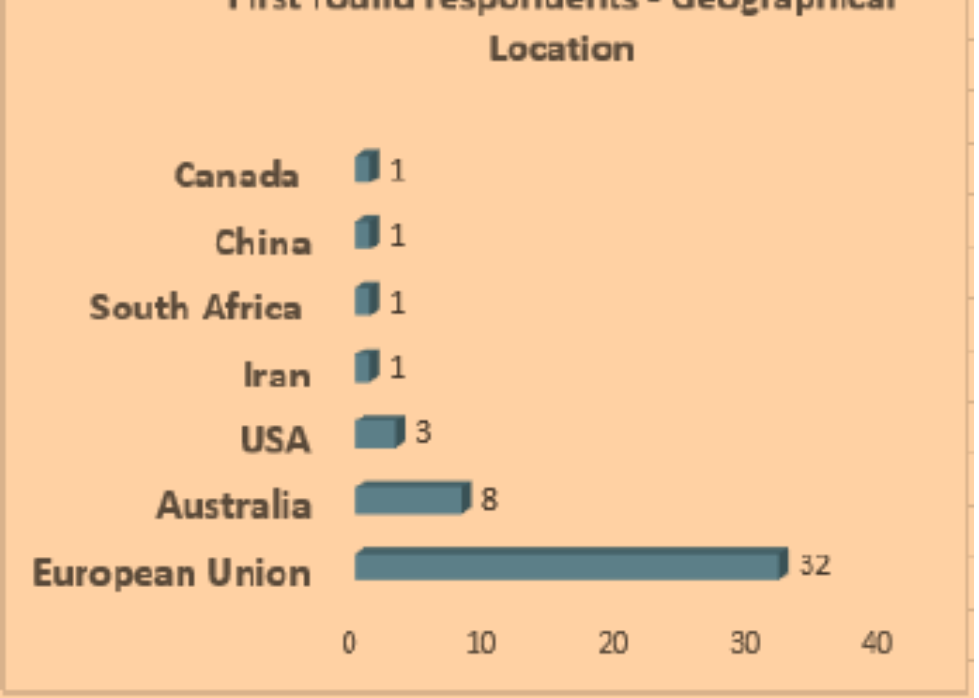


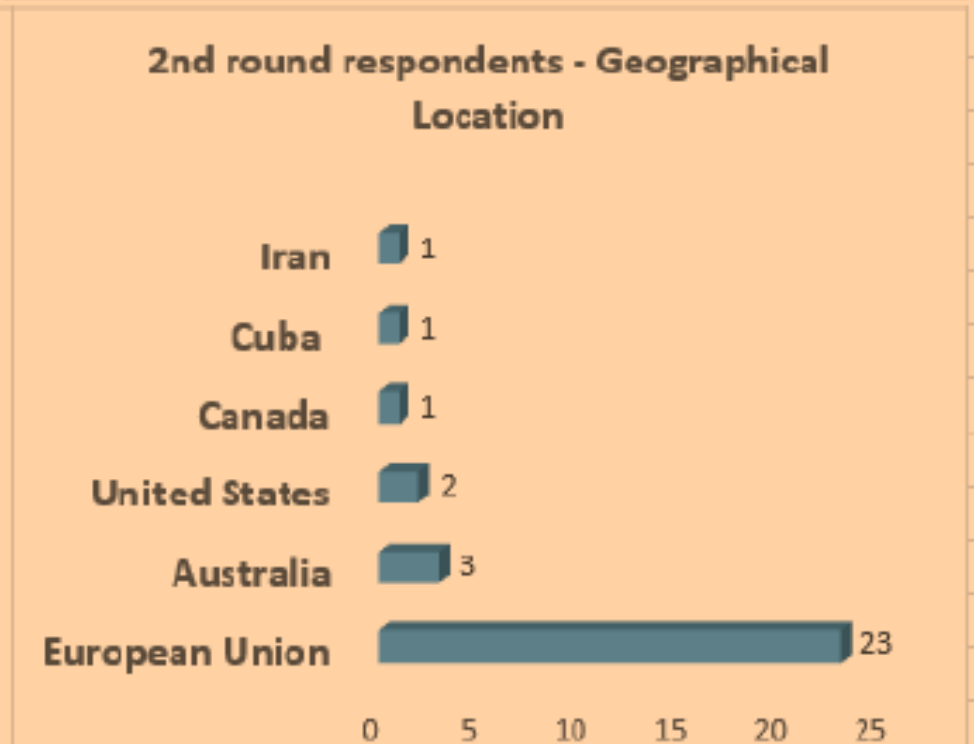
This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 776642

Delphi Survey - areas covered

- **Mass mining**
  - "By 2050, the majority of mine sites will be fully autonomous operations"
- **Mineral Exploration undercover**
  - "Improvements to professional competences will come about much more on improving 'exploration thinking' rather than data processing – a computer is not the solution to discovering ore."
- **Seafloor & Space mining**
  - "Deep-sea mining has evolved in close synergy with mining, oil & gas and space research."
- **Raw materials in the circular economy**
  - "New and improved techniques for waste retreatment and processing will be developed for multiple commodities with multiple applications – dedicated, competent professions will deal exclusively with tailings re-use as well as working together with downstream users for identification of new products and applications."
- **Future of education**
  - "Education system will be revolutionized, moving from certification and general preparation to a flexible needs-based education – professionals won't have professions, but a portfolio of abilities and skills."

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 776642





Delphi Results

- 69 Participants
- 2 rounds – April-May, 2019
- 20 statements
  - Scale of agreement
  - Expertise
  - General Comments
  - Potential skills gaps

Delphi Results - Consensus

- “Sustainability professional roles will be consolidated including **competences in social and environmental performance, Corporate Social Responsibility and post-mine rehabilitation and restoration**.”
- “While conventional mining will evolve to deeper and larger open-pits and ultra-deep underground operations, it will co-exist with novel mining methods.”
- “Geophysical and geochemical knowledge in parallel with **data science, modelling and geographic information system (GIS) skills** will be a requirement for geologists.”
- “By 2050, the majority of mine sites will be fully **autonomous operations**.”
- “**New and improved techniques for waste retreatment and processing** will be developed – dedicated, competent professions will deal exclusively **with tailings re-use as well as working together with downstream users for identification of new products and applications**.”

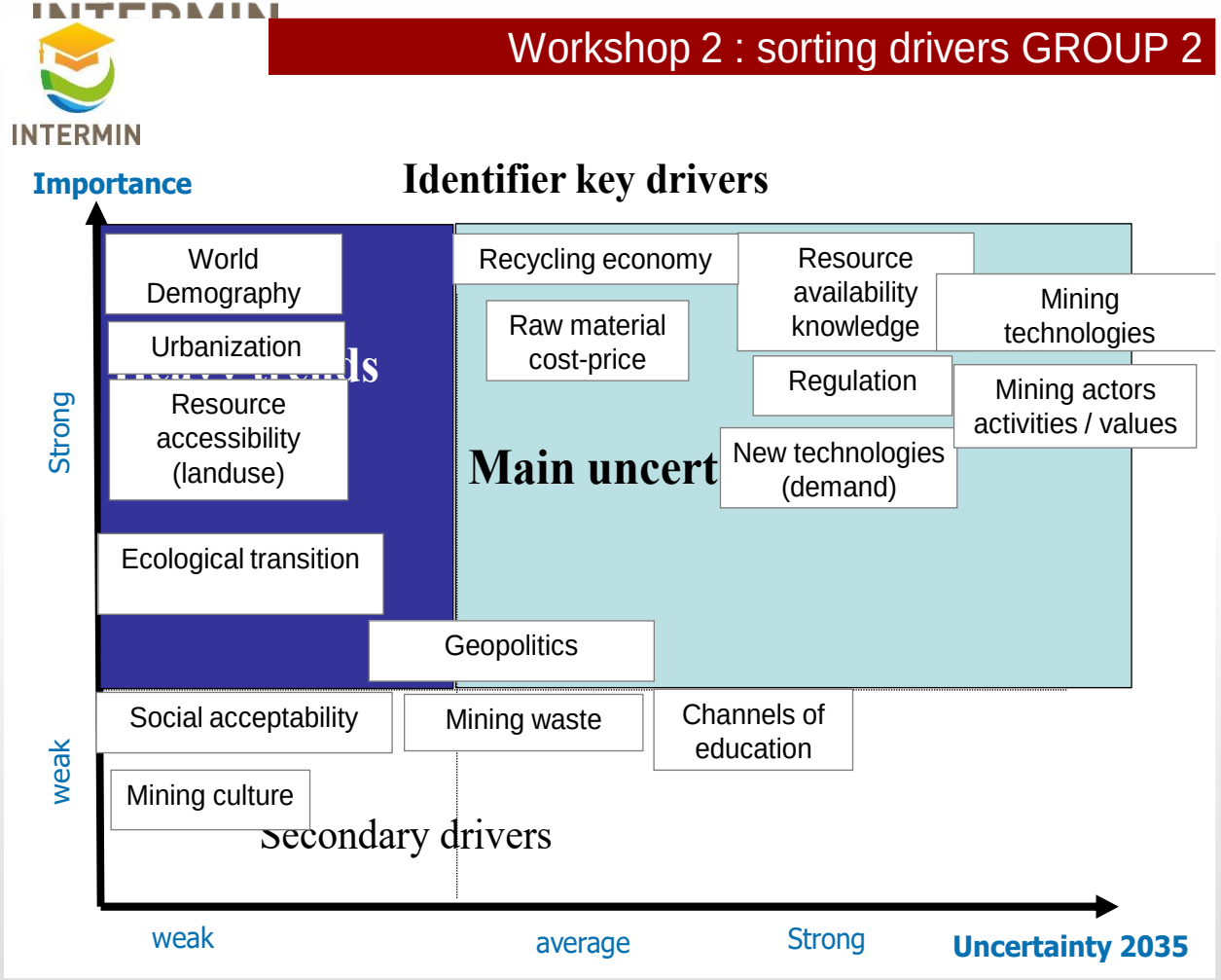
This project has received funding from the European Union’s Horizon 2020 research and innovation programme under Grant Agreement No 776642

Delphi Results - Emerging skills

- “Demands on **geotechnical, hydrogeological, and mechatronics/automation specialists** will increase, there will be shortages in these skills and gaps in the required knowledge and expertise, and a generational gap in the 40-60 year age gap.”
- “Skills related to **Electro-mechanical systems, biotechnologies, data science and management, rock fragmentation at depth.**”
- “The level of **expertise in bio-oxidation and biotechnology** in the mining sector is still limited and requires more development of trained professionals.”
- “**Geoscientists will need much more coding and data analytical skills**. Also, holistic thinking and integration of all disciplines will be necessary”
- “**Waste management, waste processing technology, legislative skills.**”
- “More knowledge about **social mechanisms** is required on the curricula for miners”

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under Grant Agreement No 776642

Competency Model - Scenarios



Areas of competency defined based on:

- **Identified skills gaps (WP2)**
- **RM qualification framework (D3.1)**
- **Skills catalogue (WP1)**

Scenario driver files description

- **8 Drivers defined in Madrid**

Workshop for hypotheses testing

Scenarios description

Integration to deliverable

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 776642

Competency Model – Scenarios

Business as usual	• Assembly of main past trend hypotheses. Not necessarily most probable in the future.
Environmentally Driven	• Responsibility of all stakeholders for the environment
Fragmentation	• A world of tensions and conflicts, companies tend to exploit new discoveries in difficult locations (e.g. deep sea; new frontiers)
Mining 5.0	• Scenario of radical innovation, new ways of mining in remote areas Invisible and profitable mining well accepted.

Different technical and soft skills needed

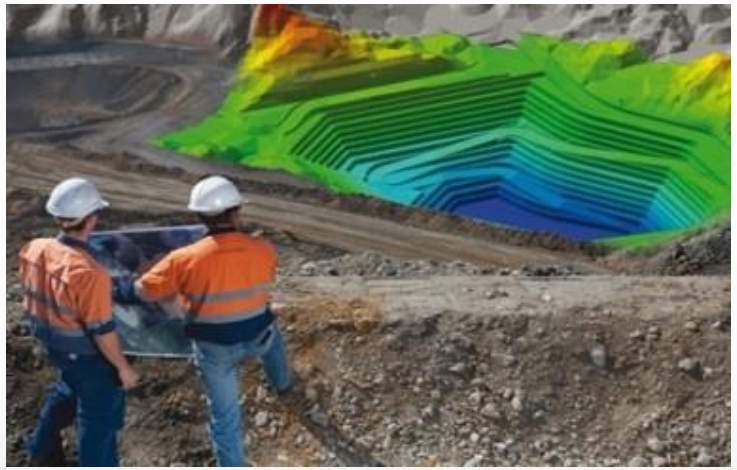
This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 776642

Competency Model

Emerging areas of RM competencies

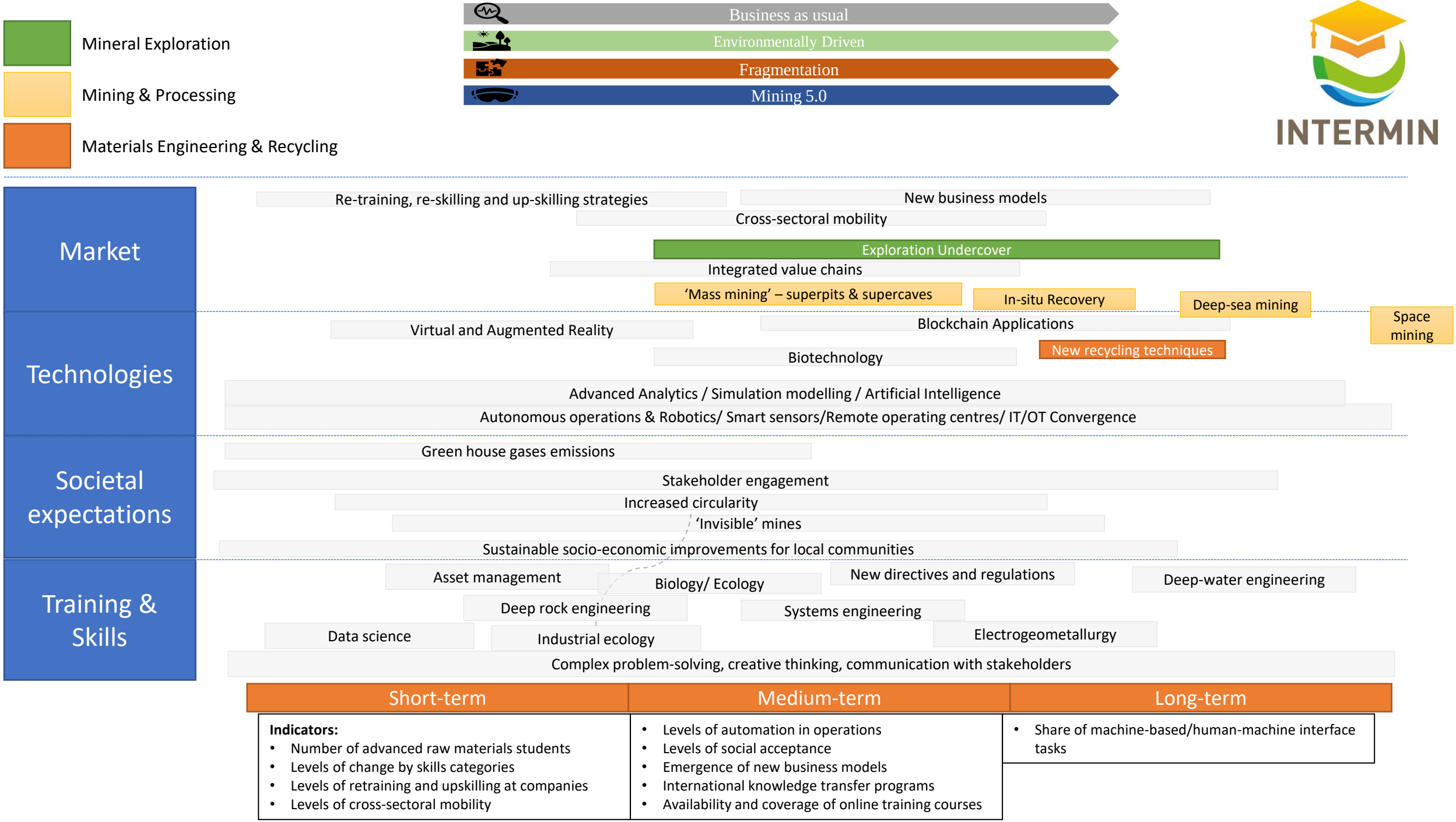
Raw Materials, Management, Conceptual, Implementation

- Advanced data analytics and simulation modeling
- ‘New frontier’ mining
- Industrial ecology
- Deep rock engineering/ geomechanics
- Investigation and development of new materials and processes
- Social mechanisms of community engagement – ‘deep’ SLO
- Market forecasting and modelling



- Blockchain-based smart contracts
- Supervision of recycling plants
- Advanced/ predictive data analytics, digital twinning and simulation modelling
- Systems Engineering
- Biotechnology
- Nanotechnology
- Electrometallurgy

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under Grant Agreement No 776642


Mineral Exploration
Mining & Processing
Materials Engineering & Recycling
Business as usual
Environmentally Driven
Fragmentation
Mining 5.0
INTERMIN
Market
Technologies
Societal expectations
Training & Skills
Re-training, re-skilling and up-skilling strategies
New business models
Cross-sectoral mobility
Exploration Undercover
Integrated value chains
'Mass mining' – superpits & supercaves
In-situ Recovery
Deep-sea mining
Space mining
Virtual and Augmented Reality
Blockchain Applications
New recycling techniques
Biotechnology
Advanced Analytics / Simulation modelling / Artificial Intelligence
Autonomous operations & Robotics/ Smart sensors/Remote operating centres/ IT/OT Convergence
Green house gases emissions
Stakeholder engagement
Increased circularity
'Invisible' mines
Sustainable socio-economic improvements for local communities
Asset management
Biology/ Ecology
New directives and regulations
Deep-water engineering
Deep rock engineering
Systems engineering
Data science
Industrial ecology
Electrogeometallurgy
Complex problem-solving, creative thinking, communication with stakeholders
Short-term
Medium-term
Long-term
Indicators:
• Number of advanced raw materials students
• Levels of change by skills categories
• Levels of retraining and upskilling at companies
• Levels of cross-sectoral mobility
• Levels of automation in operations
• Levels of social acceptance
• Emergence of new business models
• International knowledge transfer programs
• Availability and coverage of online training courses
• Share of machine-based/human-machine interface tasks

LPRC

LA PALMA RESEARCH CENTRE

Thank you for your attention!

Contact:
luislopes@lapalmacentre.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 776642