

Smart Mine of the Future

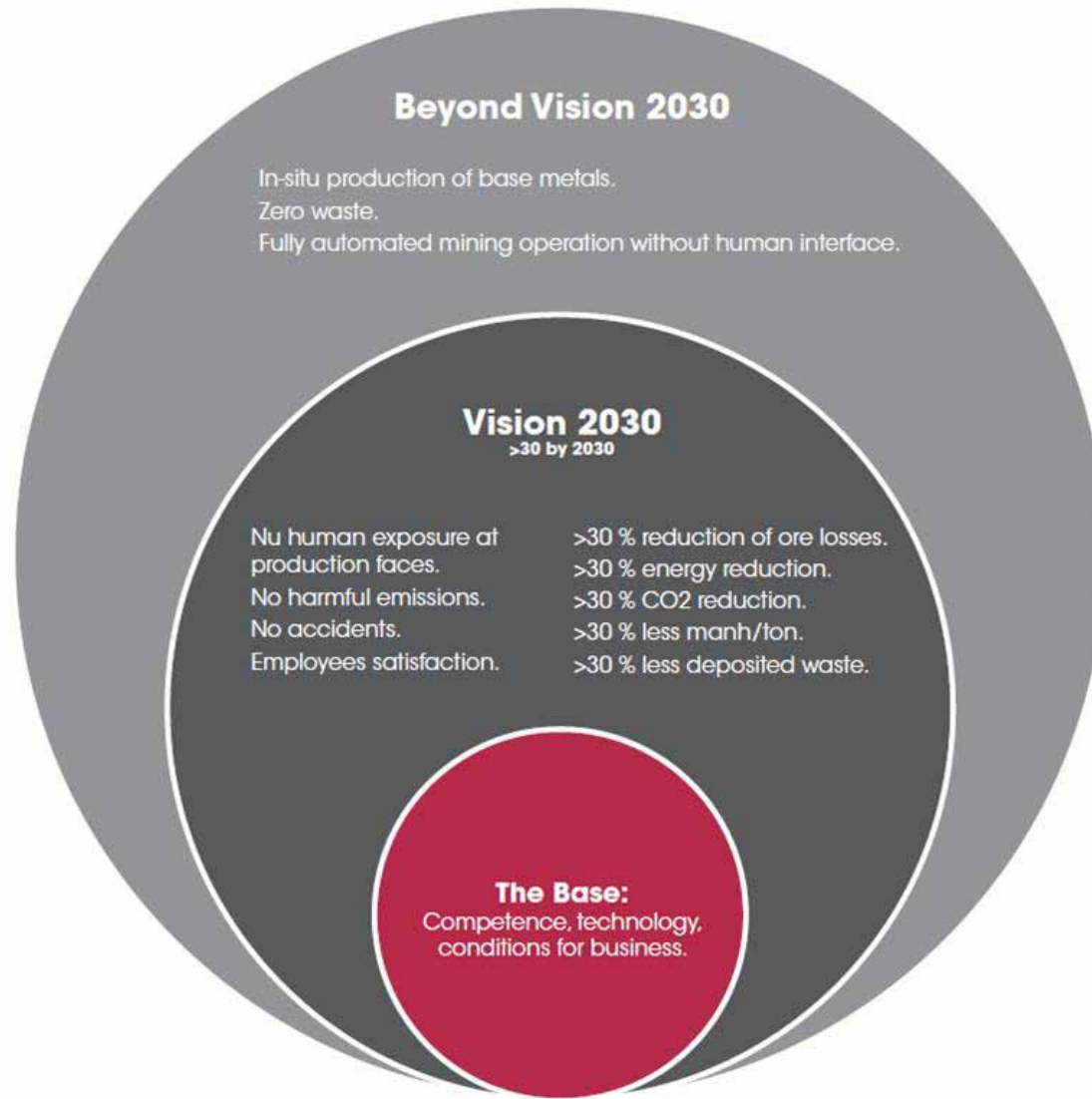
Johan Hedlin

CEO, The Bergforsk Foundation

CEO, Nordic Rock Tech Centre AB



The vision – Mine of the Future



**Regional
centre**



Mine site

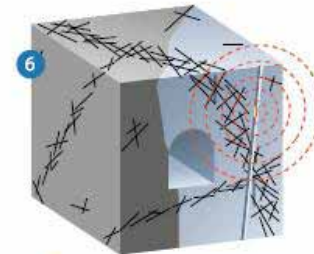
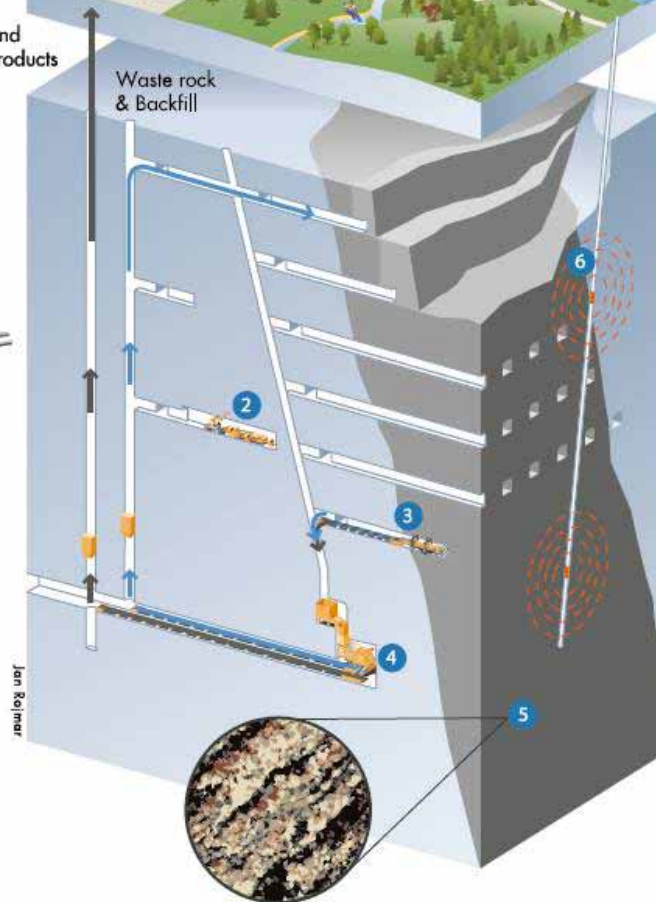
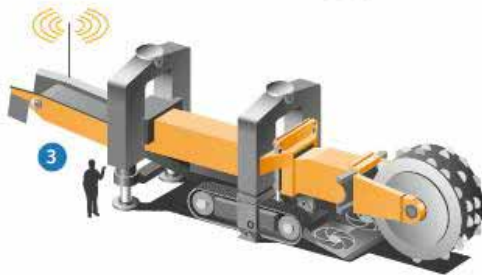


Suppliers



Ore and
by-products

Waste rock
& Backfill



Smart Mine of the Future

RTC
ROCK TECH CENTRE

Regional centre

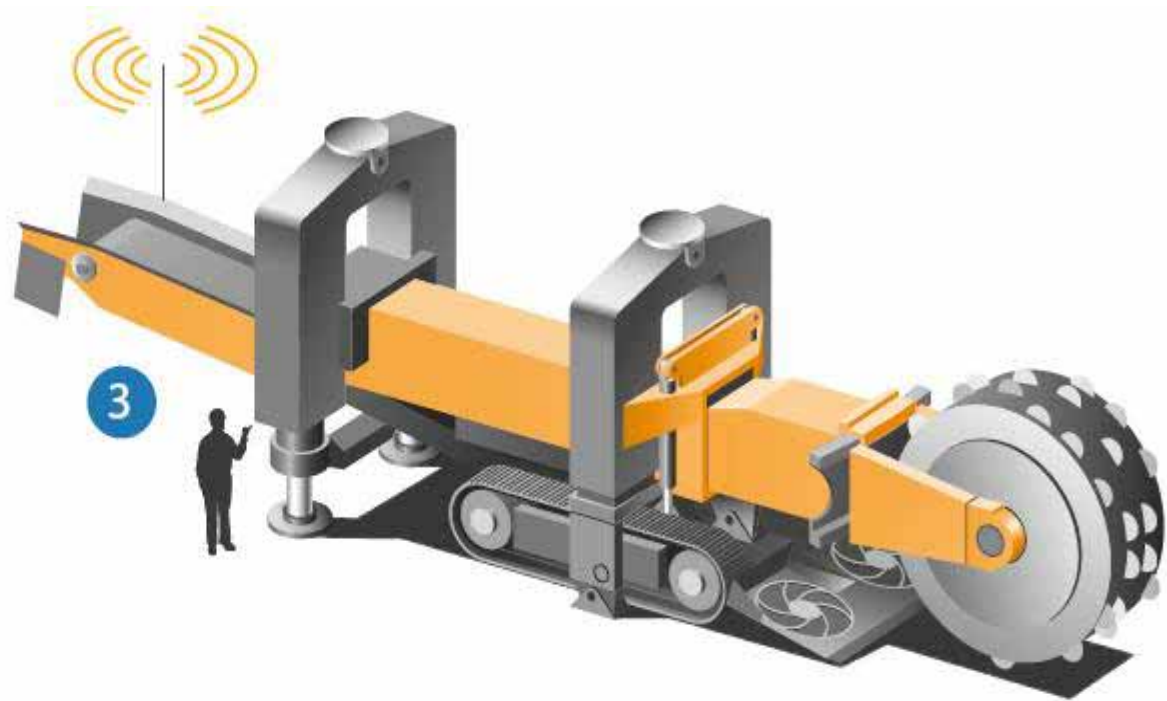


- 1. One control room.** The control room receives on-line processed information from the rock, from the personnel and from the machinery and equipments that permits the control and fine-tuning of the complete operation (process control and product control) from resource characterisation to the final product. Sensors and the extensive use of cameras and image techniques permit “live performances” in the control room or elsewhere as needed.



2. **No human presence in the production areas.** All work processes (including rock characterisation) are remote controlled or automated. Special robots are developed for the preventive maintenance of equipment and safe retrieval operations. The maintenance of the robots as well as necessary equipment repair are executed in structurally safe underground vaults. All equipment underground is electrical and the use of diesel is banned.

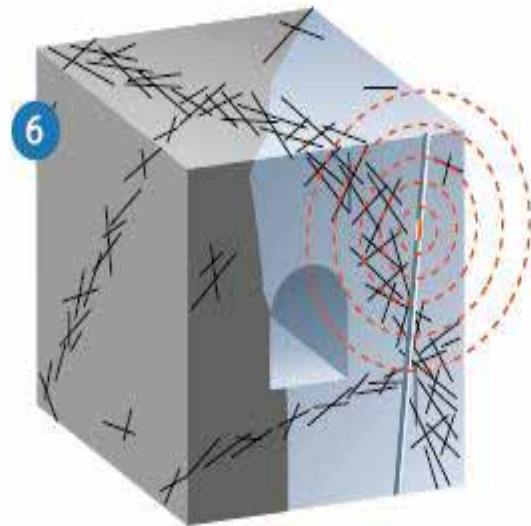
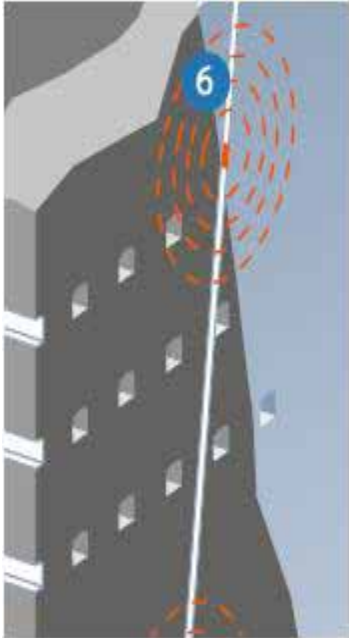




- 3. Continuous mechanical excavation.** The continuous flow is a key issue for lean mining and further automation. The future mine is a continuous process, and therefore continuous mechanical operation is also used in hard rock



4. **Pre-concentration.** Barren rock is separated underground to minimise energy consumption for haulage and transport as well as environmental impact on the surface.



6. Resource characterisation – structural control. Systems are used that describe the rock with its structures to aid process control.

Suppliers



7. Final product. For reasons of sustainability, waste rock should be turned into products. The metal should, if possible, be manufactured at the mine site to avoid unnecessary transportation. Added value generated in situ should also contribute to a richer social life at the mine site.

Way forward ?

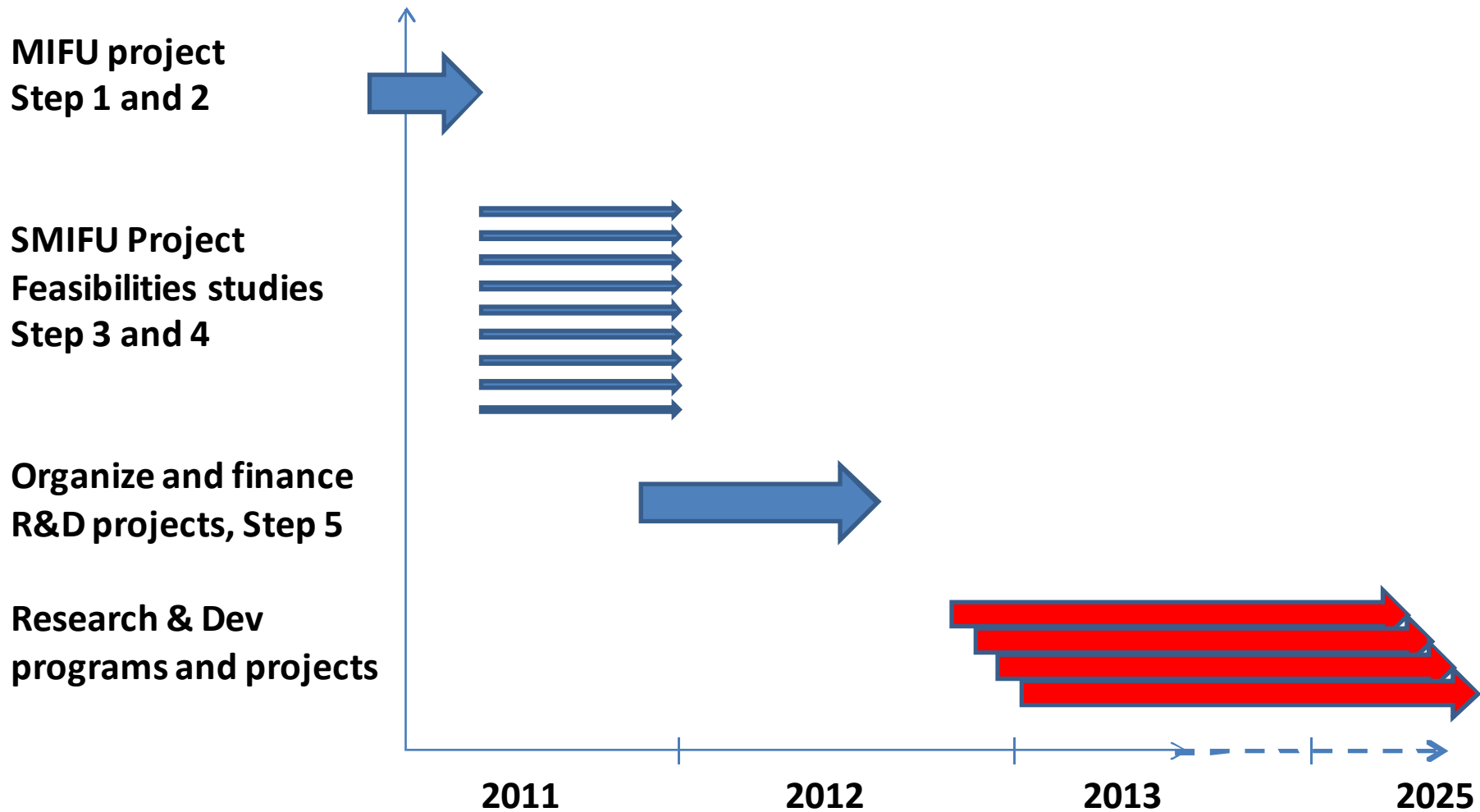
Smart Mine of the Future

RTC
ROCK TECH CENTRE

Our process way forward

1. Describe the vision and long term objectives
2. Identify certain areas of needs and prioritize
3. Carry out feasibility studies
4. Identify research and development areas
5. Organize, finance and start R&D projects

Our process way forward



Smart Mine of the Future

Project organization – feasibility studies

Steering committee

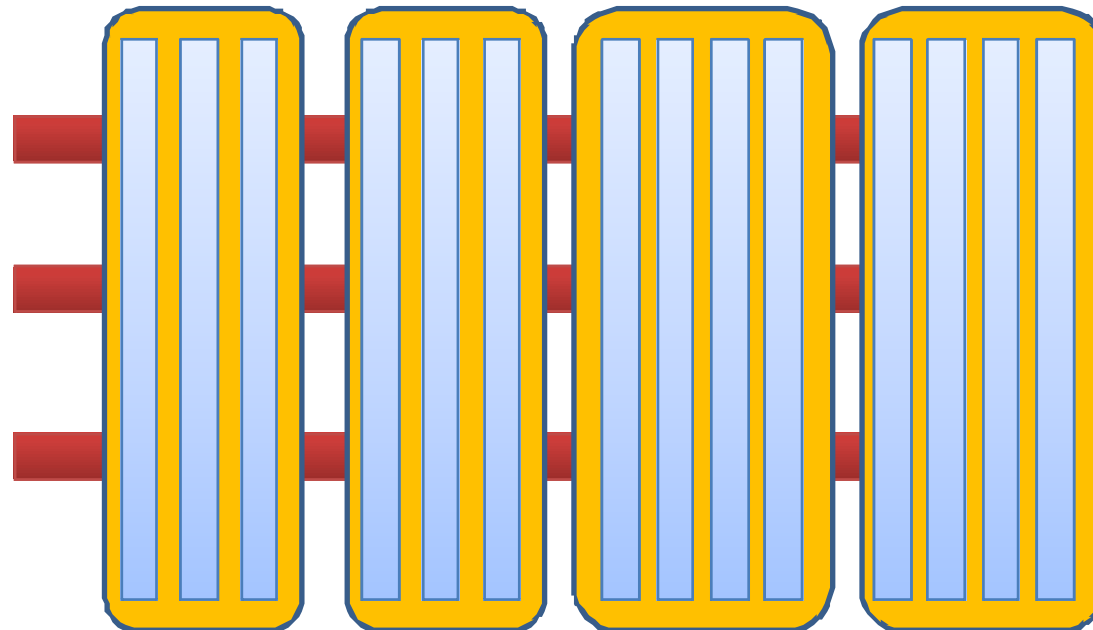
University AGH
Luleå University of
Technology
KGHM, Boliden, LKAB

Future development, next phase, wp 15

Coordination
Environmental

Coordination
Safety

Coordination
Lean



Work packages 1 to 14

Project management and administration, RTC

Smart Mine of the Future

Feasibility studies

1. Zero entry in the production area
 2. Rock mechanics and ground support
 3. New power sources for underground vehicles and equipment
 4. Basic mechanisms for breakage on hard rocks.
 5. Reduce nitrogen emissions
 6. Pyrite removal
 7. Pre-concentration
 8. Improved ore recovery
 9. Process and equipment reliability
 10. Continuous mechanical excavation
 11. Integrated Process control by improved connectivity, model.
 12. Resource characterisation and Sensor and auto data proc
 13. The Attractive Workplace – design guidelines
 14. Mine site metal production
 15. Future development, next phase
- Åke Kruukka, LKAB
Per Ivar Marklund, Boliden
Stefan Törnman, LKAB
University AGH Poland
Anders Lundkvist, LKAB
Pia Lindström, Boliden
Witold Pawlos, KGHM, MPP
Hamid -Reza Manouchehri, Boliden
Sunniva Haugen, Boliden
Krzysztof Barrek, KGHM
Å Krukka, M Strömsten, LKAB
Perti Lamberg, LTU
Elzbieta Idzik, KGHM
Andreas Berggren, Boliden
Johan Hedlin , RTC

Companies and organizations involved in the feasibility studies

LKAB, Boliden, KGHM

Luleå University of Technology, University AGH

Metso, Atlas Copco, Akzo, Georange, Sandvik, ÅF, ABB,
Outotech, Gett

amongst others.

Summarize

Great challenges

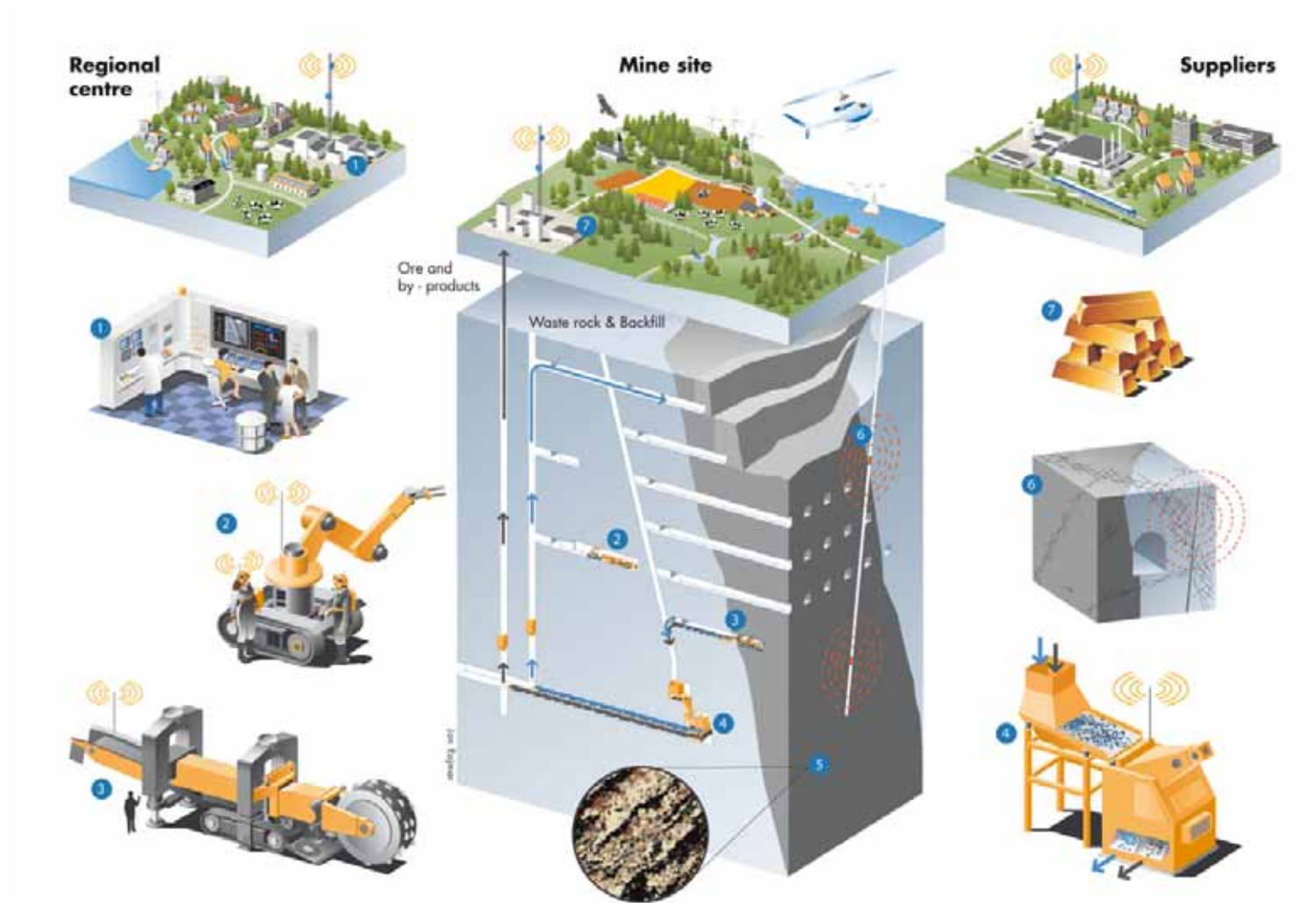
Great possibilities

- for the mining industry
- for the suppliers,
- for Sweden and Europe

We need to cooperate

National and EU based research programs

Thanks!



Smart Mine of the Future