Engineering balanced sustainability™

Kestävä kehitys liiketoiminnan ajurina

Suomen mineraalistrategia
Workshop 2
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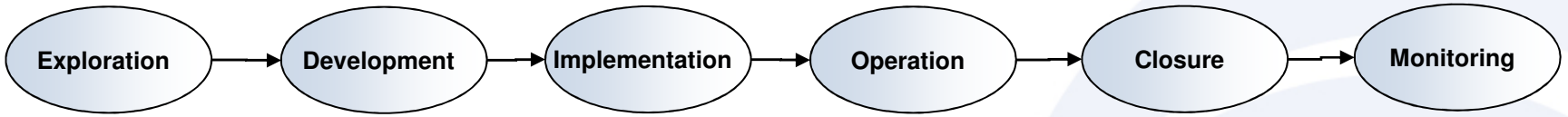
General background

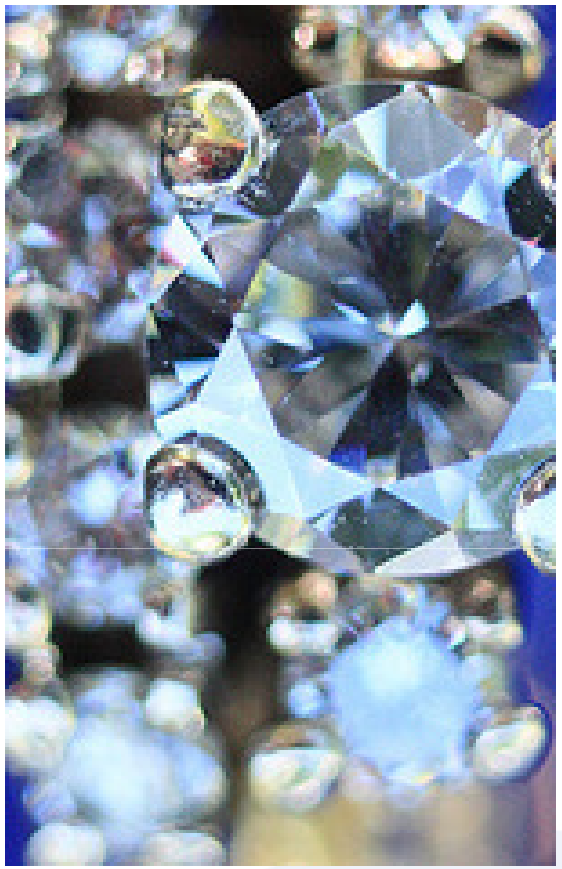
- Mine development is a long process that requires expertise e.g. from below mentioned disciplines:

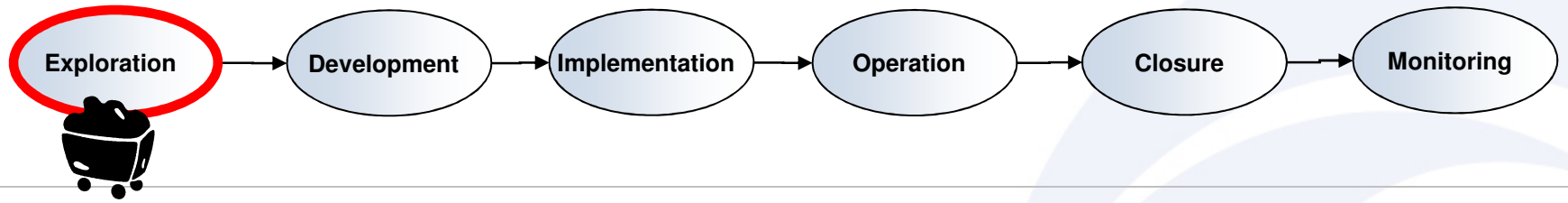
- Exploration drilling and geology services
- Geological and geophysical consulting
- Environmental research and services
- Logistics consulting services
- EIAs and Permitting
- Technical design:
  - Mine site infra, waste storage areas, dams
  - Civil engineering
  - Process engineering
  - Associated infrastructure (railways, ports etc.) planning



Exploration

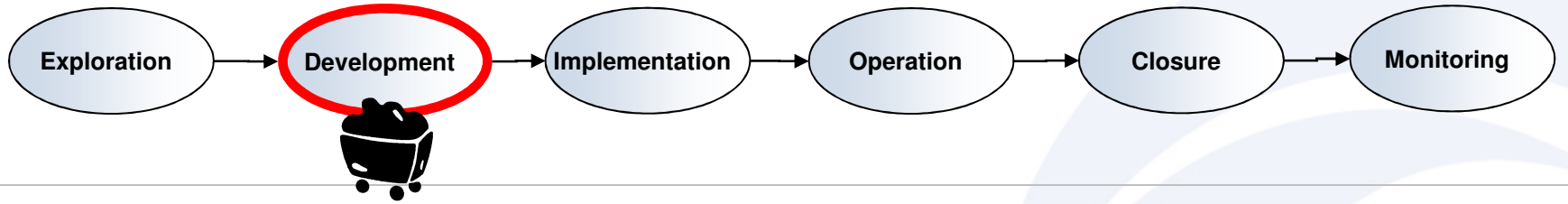
- Targeting for mineral research
- Regional and site studies
- Planning, managing and reporting of works
- Airborne, ground and drillhole geophysical surveys, data processing and modeling
- Drilling and Sampling
- Geological Mapping on ground and drillcores
- Petrography
- Ore Mineralogical Studies
- Geochemical Analysis
- Mining Geology
- 3D Modeling of the target
- Resources / Reserves Estimate





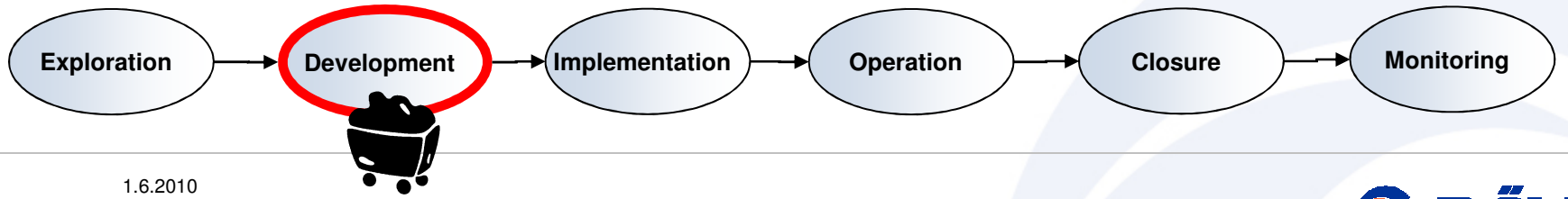
Development; Economic Studies and Evaluations

- Mineral Commodities Market Study
- Mineral Commodities Logistic and Supply Chain Study (including Foreign Markets)
- Investment Estimate
- Operating Costs Estimate
- Technical, Economic, Environmental & Logistics Feasibility Studies
- Risk Analysis
- Strategic Planning and Master Plan
- Ore Reserve and Mine Evaluation / *Due Diligence*



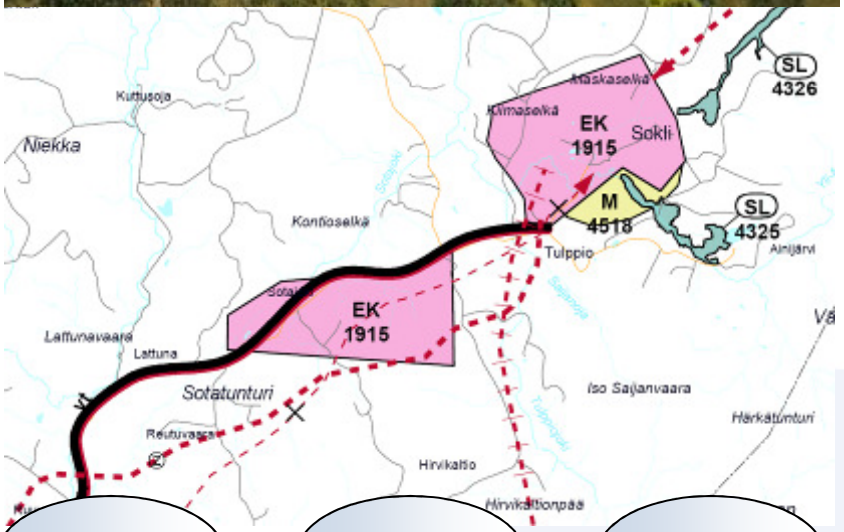
Development; Environmental Studies

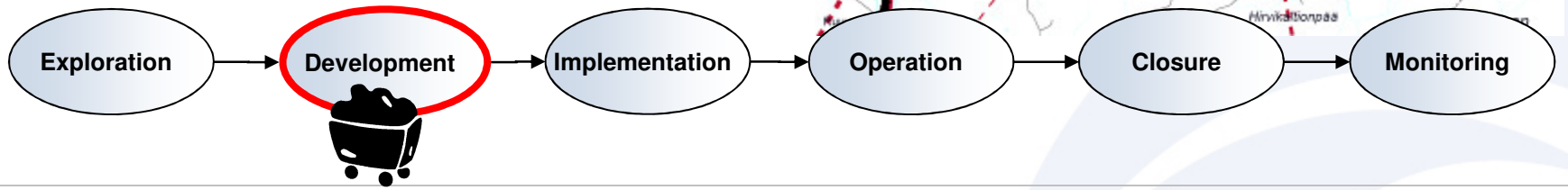
- Base Line Studies
- Environmental License
  - Environmental Impact Assessment and its Report (EIA/RIMA)
  - Simplified Environmental Study (EAS) and Environmental Reports
  - Natura 2000 assessments
- Environmental Control
  - Water and Effluents Treatment Projects
  - Water Intake and Effluents Disposal
  - Air and Water Monitoring Plan
  - Waste Inventory and Industrial Landfills
- Environmental Quality
  - Water Quality and Dilution and Clearance River Capacity
  - Air Quality and Atmospheric Dispersion Study
  - Soil and Groundwater Quality Assessment and Remediation



Development; Land use planning

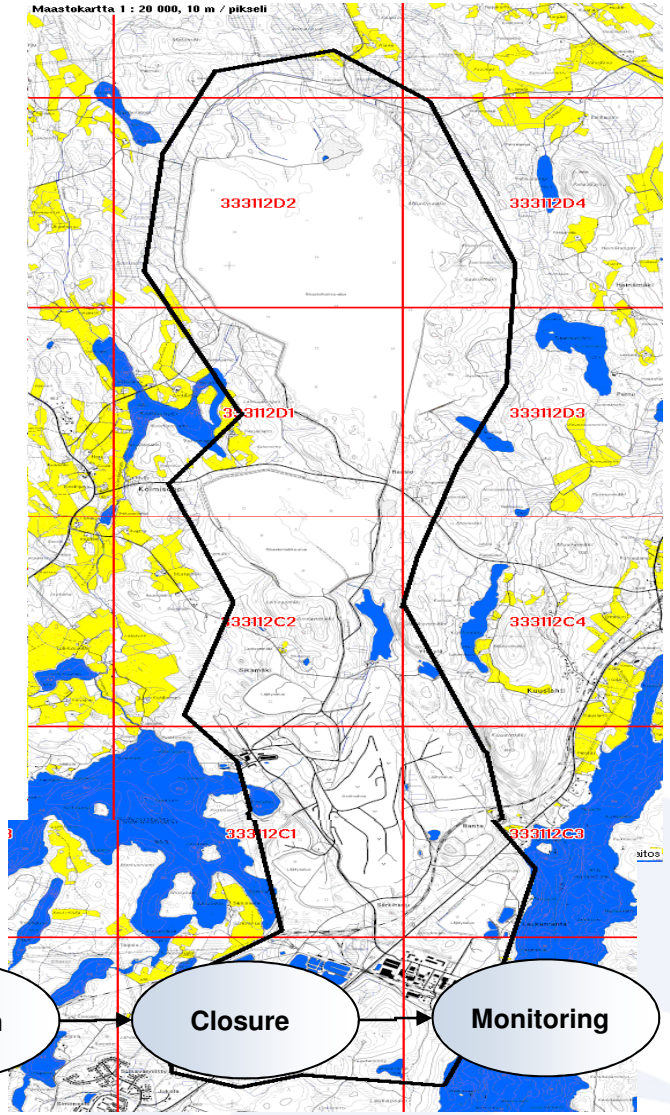
- Regional planning
  - Mining area
  - Connections; railway, roads, power
- Master planning
  - Local land use
- Detail planning
  - Buildings and infrastructure

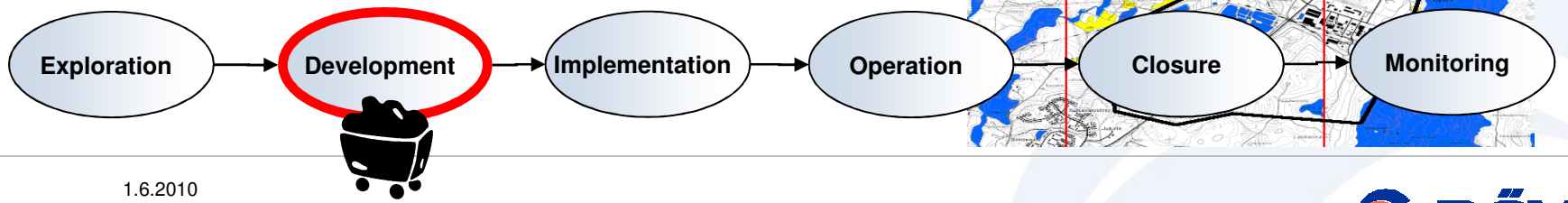




Development; Permits

- Exploration reservations and claim applications
- Notification for mining trials
- Mining right applications
- Environmental Impact Assessment (EIA)
- Environmental and water permit applications
- Permit applications for chemicals
- Safety studies and applications for plant safety
- Building permit applications
- Dam safety permit documentation etc.



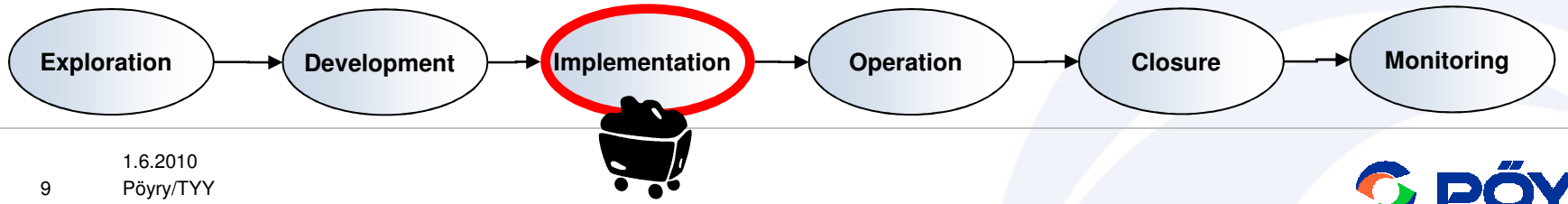


Mining and Quarry

Annual Mining Planning

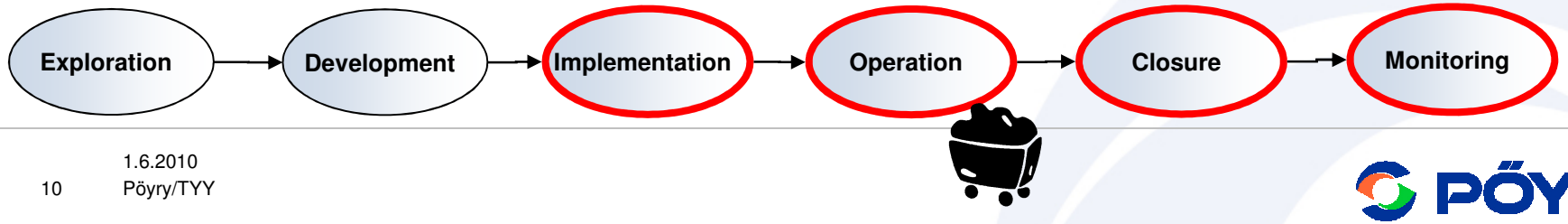
- Mine Development
- Mine Infrastructure:
  - Roads / Railroads
  - Energy
  - Water
  - Rejects Dam
  - Facilities and Utilities
  - Delivery and Expedition
- Mine Closure Plans
- Degraded Area Recovering Plan (PRAD)
- Safety, Health and Environment
- Environmental Sustainability

Suurikuusikko (Kittilä) mine in September 2007. The circular road indicates the final extent of the open pit. View to the north. Photo courtesy Agnico-Eagle Mines Limited.



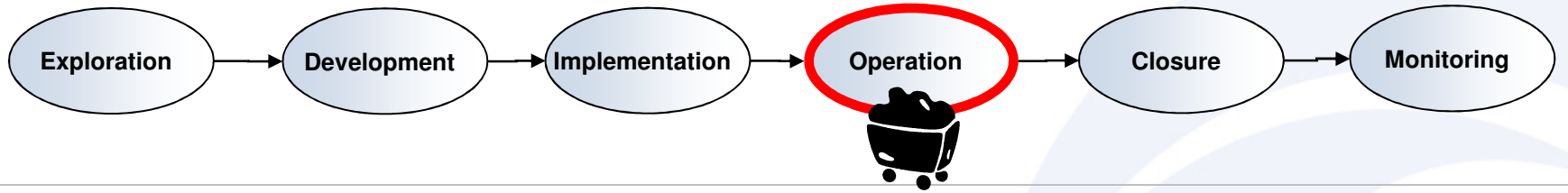
Environmental engineering and monitoring

- Ground water studies, modelling and migration of different compounds and elements
- Monitoring of mining and concentration plant activities
- Monitoring of impacts on watercourses and fisheries
- Noise measurements, studies and modelling services
- Dust measurements and monitoring
- Vibration measurements and monitoring
- Laboratory services related to environment
- Monitoring after closure



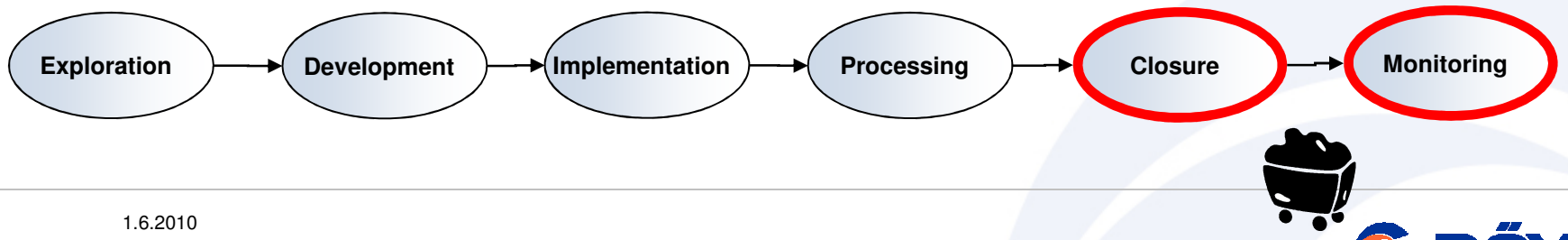
Operation

- Ore Batch Testing in Bench Scale
- Ore Continuous Testing in Pilot Concentration Plant
- Mineral Processing Flowsheet Design Alternatives Study
- Ore Processing Mill Project
- Equipment and Process Performance Improvement
- Mill and Equipment Conceptual, Basic and Detailed Project
- Maintenance services
- Local service



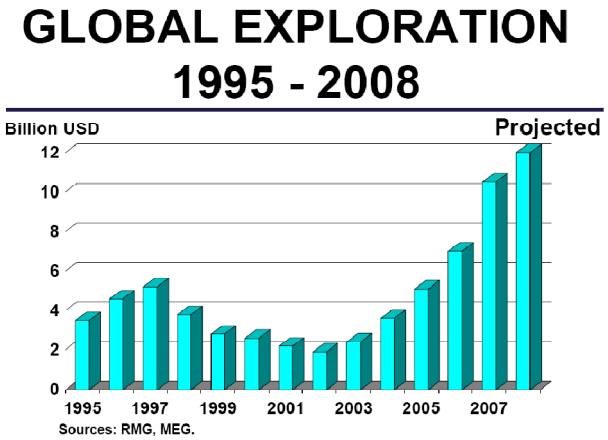
Closure and Monitoring

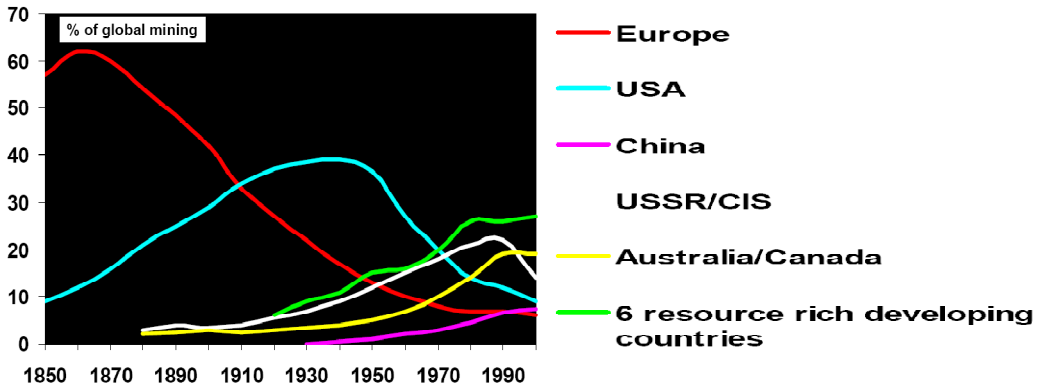
- Mine Closure Plans
- Degraded Area Recovering Plan (PRAD);
- Environmental monitoring and control



Drivers for demand

- The world economies need raw materials, especially countries like China and India have a huge demand for steel, concrete and other commodities.
- The trend of raw material demand has been increasing steadily
- Mining is preceded by exploration that shows the trend described below.





Raw Materials Group, 2007

- EU area is especially dependent on import materials. There is a new raw material initiative being prepared that considers this aspect.
- Due to country risk and unstable conditions (legal etc.) the politically stable countries are gaining importance on the market. This favors e.g. Scandinavian countries.

Future trends

- The easily exploited ore deposits are becoming more and more scarce. This requires **new solutions and considerable efforts** for exploration and mining activities. Also **environmental awareness** is increasing constantly. Most of the financers do not participate to environmentally suspicious projects.
- As the richest deposits are being exhausted new **deposits with lower ore grades** and increasing quantities of byproducts (tailings, waste rock etc.) are coming into production.

- Ore:waste-ratio development together with increasing environmental awareness and reclamation requirements emphasize the **waste management issues** and possible further utilization of these fractions (e.g. rare earth elements).
- Open pit mining has been the most common mining method during the latest decades. However **underground mining** may gain significance in the future.

requirements regarding EHS issues

Effective management of environmental, health, and safety (EHS) issues entails the inclusion of EHS considerations into corporate- and facility-level business processes in an organized, hierarchical approach that includes the following steps:

Identifying EHS project hazards[3] and associated risks[4] as early as possible in the facility development or project cycle, including the incorporation of EHS considerations into the site selection process, product design process, engineering planning process for capital requests, engineering work orders, facility modification authorizations, or layout and process change plans.

Favoring strategies that eliminate the cause of the hazard at its source, for example, by selecting less hazardous materials or processes that avoid the need for EHS controls.

Preparing workers and nearby communities to respond to accidents, including providing technical and financial resources to effectively and safely control such events, and restoring workplace and community environments to a safe and healthy condition.

EHS General Guidelines

Financing for Mining Projects

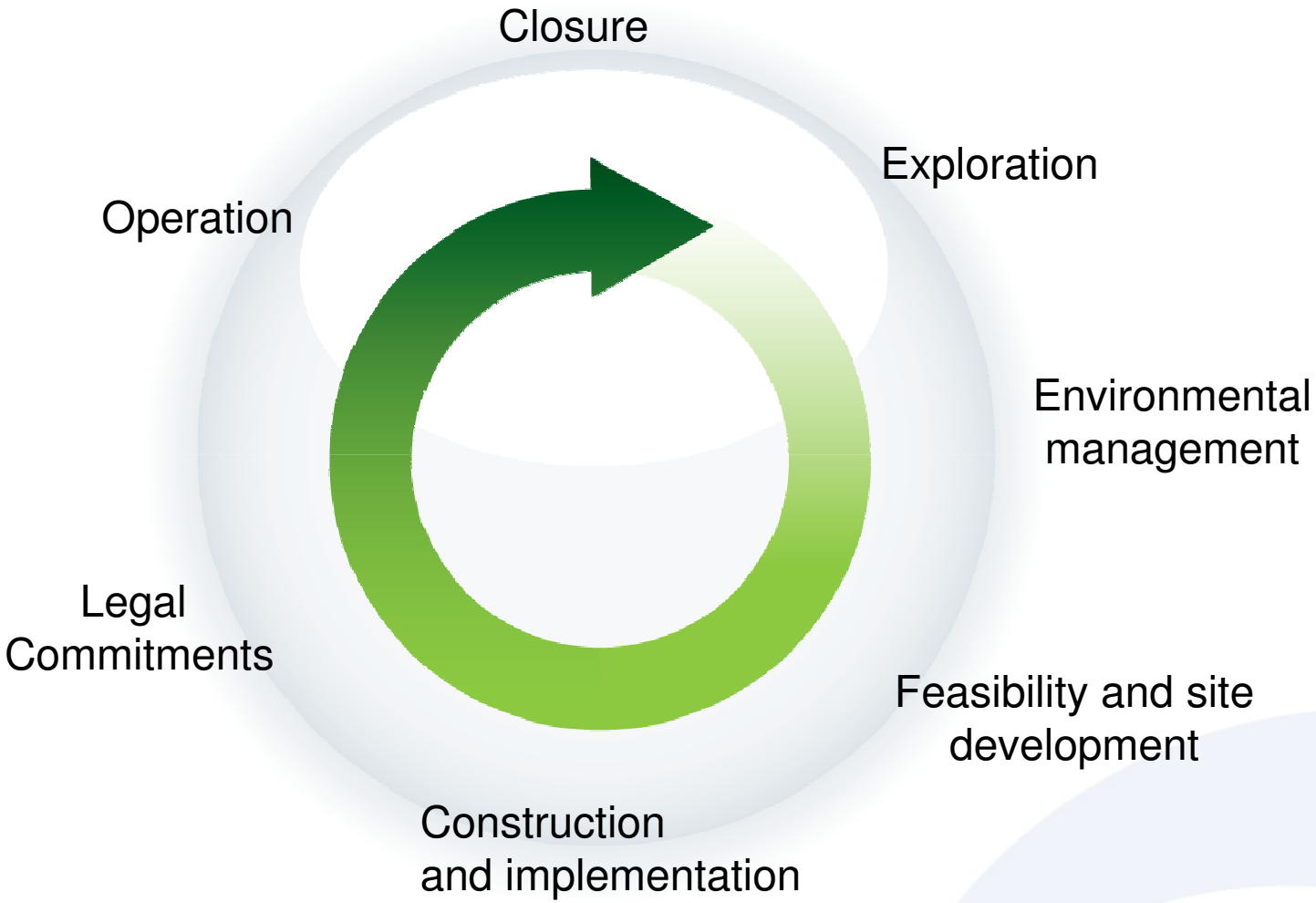
- ”The Bank pays particular attention to environmental sustainability, the mitigation of and adaptation to climate change, natural resource management, protection of biodiversity and safeguards to improvements of the general and urban environment.”

- ”Mine closure plans, including the elaboration of financial requirements, also form one of the requirements of the EIB (at the early project appraisal stage these can only be preliminary). As to guidelines on tailing, waste disposal and use of chemicals, EIB appraisal includes verification that the relevant environmental issues have been properly addressed by the promoter and mitigating measures incorporated into the project.”

"Seminar Themes:

- Abstracts fall into the following broad themes:
- Improvements in design of tailings storage facilities
- Dam break analysis: appropriate tools and calibrated case studies
- Appropriate in situ testing techniques
- The application of geosynthetics in mine waste management
- Use of mining waste in backfilling of mining voids
- Mitigating the impacts of geochemical problems
- New approaches to the management of waste rock
- Accounting for climate change
- Sustainable closure and the concept of designing for perpetuity
- Improved management and operational strategies to minimise risk"

Lifetime Sustainability



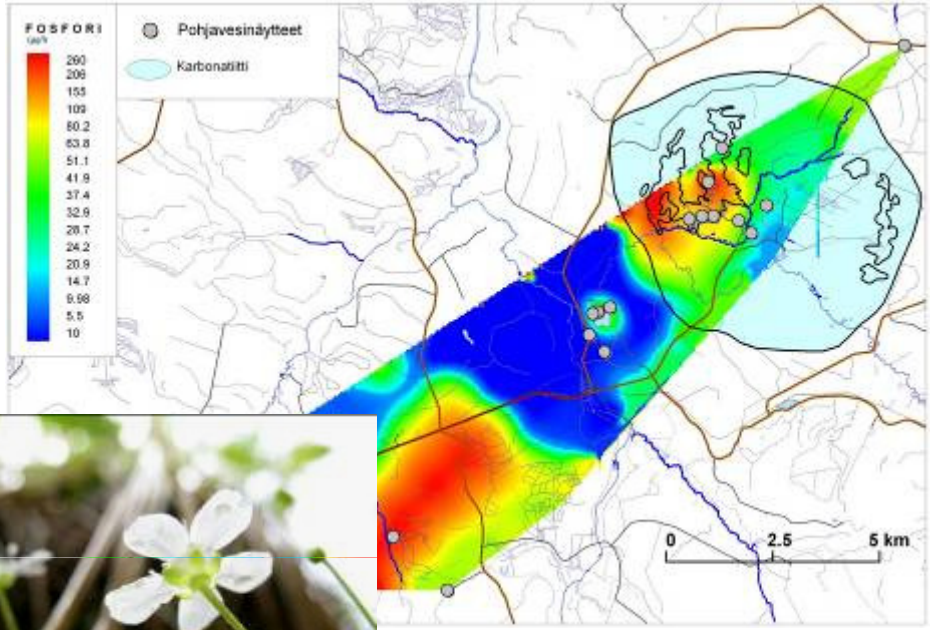
Exploration and mine development

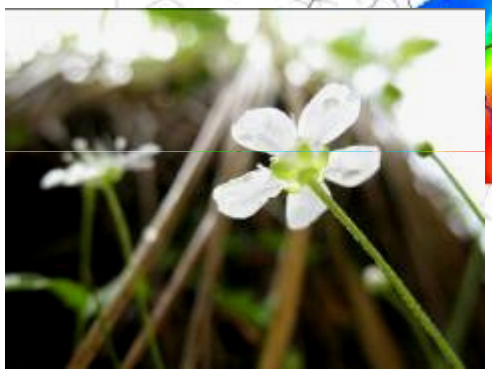
Model Projects

Yara Finland Oy, Sokli, Finland 2007-2009

- Project:
  - Planned phosphate mine in Eastern Lapland. Investment value 500-800 M€
- Scope:
  - Coordination of EIA and land use planning processes
  - Site layout planning
  - EIA of the mining area
  - EIA of the power line
  - Regional land use plan
  - Master land use plan
- Also strong contribution to Yara's Siilinjärvi phosphate mine extension and operations,

  The biggest phosphate mine in western Europe





Quick fact

Sokli deposit

- Reserves >115 Mt of P_2O_5
- Ore mining XX Mt/a
- Planned phosphate production 5 Mt/a
- Opening planned 2016
- Planned mine life >20 years

CMEC Belinga Iron Ore Mine, Gabon in 2009

Project:

Belinga Mining Project : Complete Environmental and Social Impact Study (ESIA) of the Belinga Mine and its 3 related subprojects

Scope:

The Belinga site, situated in northeastern Gabon, is one of the largest reserves of unexploited iron in the world. The goal was to prepare an ESIA report for the following subprojects:

- Belinga iron ore mine,
- Designated harbour at Cap Santa Clara,
- Designated hydroelectric dam at the level of the Kongou falls,
- Electric power transmission lines and the railway line between the Belinga mine and the harbour

Copperbelt Environment Project, Zambia in 2007 - 2010

The project included the following main components

(a) Specifications for Environmental Monitoring Equipment

(b) Review of Environmental Impact Assessments (EIAs) and Environmental Management Plans (EMPs), including training of the ECZ and MSD staff

(c) Auditing of EMPs, including training of the ECZ and MSD staff

(d) Environmental Monitoring guidelines relating to the following;

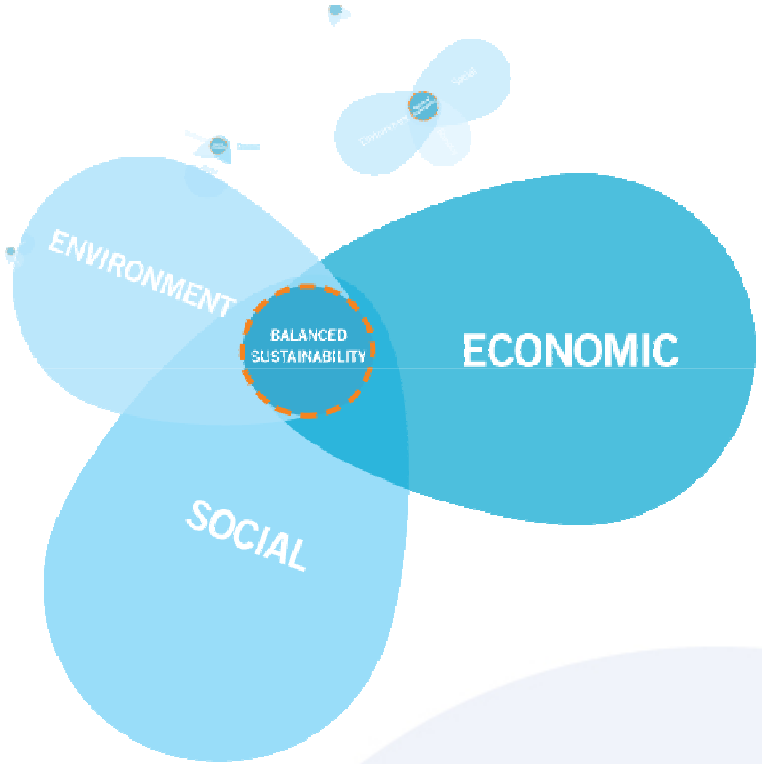
1. Water/Wastewater monitoring
2. Air monitoring
3. Land degradation monitoring
4. Noise monitoring
5. Solid waste monitoring (emphasizing on mining waste)

(e) Environmental Emergency Response System

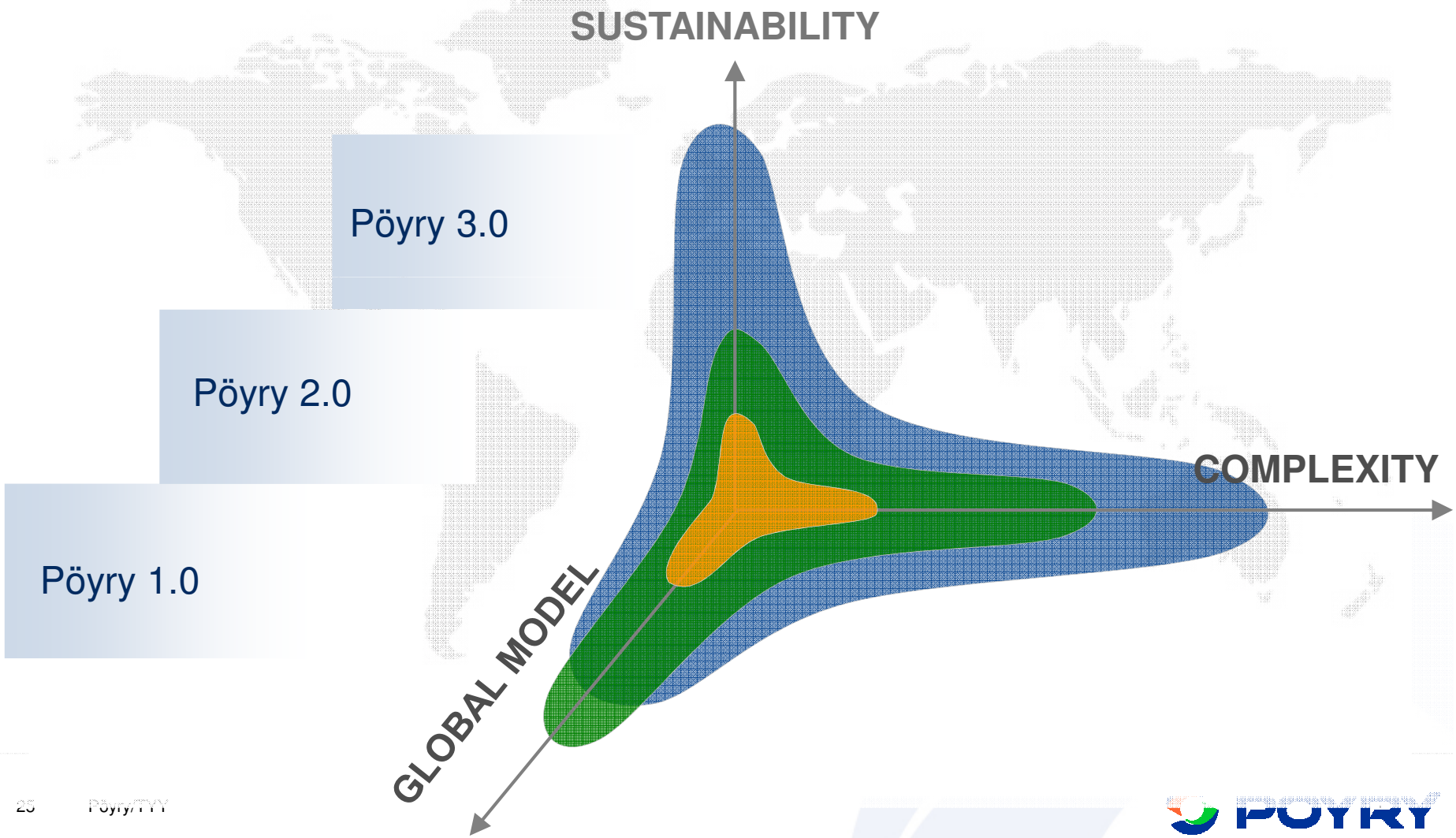
(f) Environmental Data Management System

The world calls for Balanced sustainability™

- Balanced sustainability™ is a holistic, multidimensional approach to sustainability that we apply to everything we do.
- It strives to achieve a balance between economic, environmental and social dimensions, as most appropriate to the nature of the project and where in the world we are working.
- Pöyry will be designing realistic and innovative solutions that consider these three dimensions.
- We will continue to work in provocative areas, but we will push the envelope and propose more balanced solutions that offer the best possible path forward.



Dimensions of growth



Our vision

The global thought leader in engineering balanced sustainability for a complex world

- Engineering has always been at the core of Pöyry
- For decades we have been involved in projects with sustainable dimensions
- The key difference now is that sustainability is placed at the heart of everything we do

PÖYRY

Engineering balanced sustainability™