EMMC
EU Mining Mentor Centre

Mining – Environment – Waste
W E Falck
Scientific Advice
Added Knowledge – Added Value

Integrating Environmental Remediation and Decommissioning into the Life-Cycle Management of Mining and Milling Sites

Sustainability of Mineral Resources and the Environment
21st – 22nd November 2016

Prof. Dr. W. Eberhard Falck, WEFalck Scientific Advisory Services

Context: Public Perception of Mining

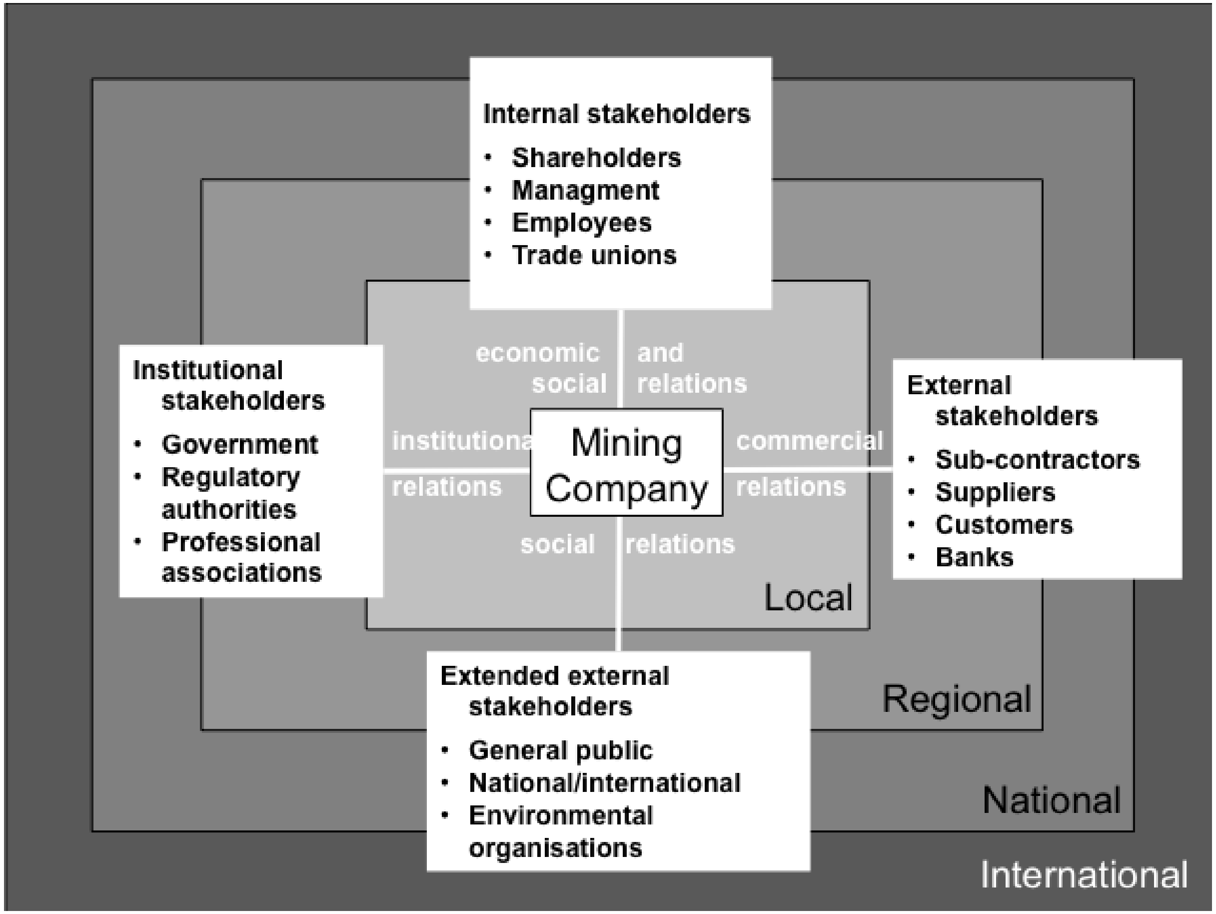
- Mining is indispensable for modern industrial economies, but it has a price: (negative) environmental and social impacts
- The picture the public has of mining is shaped by the past
- Historically, mining companies often showed social / environmental indifference and a nonchalant attitude towards impacts
- Modern mining is based on a life-cycle management approach that strifes to minimise such impact along all phases of operation

Mining and Stakeholders

- A mine impacts its environment and its socio-economic context
- People have a natural and vested interest in the sustainable development of their regions
- Different stakeholders value impacts differently, depending on perceived benefits and burdens
- Misunderstandings or disagreements over values and their non-respect by some actors are at the core of conflicts
- Thus, mining projects, not only require (formal) environmental licenses, but also an (informal) ‚social license to operate' (SLO)
- Stakeholders are concerned about the whole life-cycle of a mine / mill

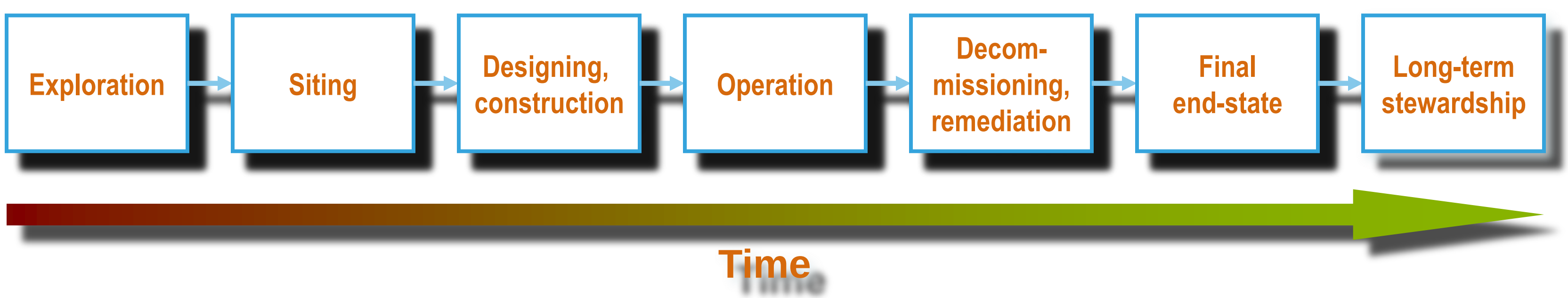
Who Are the Stakeholders ?

- A stakeholder can be ANY person or group, who claims to have an interest in a project
- Obtaining a SLO first of all requires that the mine operators engage with the different stakeholders
- A SLO is based on trust between all parties



The Life-Cycle of a Mine Site

- exploration
- mining & milling
  - mining and milling residues management
  - water management
- closure
- decommissioning & remediation
- long-term stewardship



Why decommissioning and remediation ?

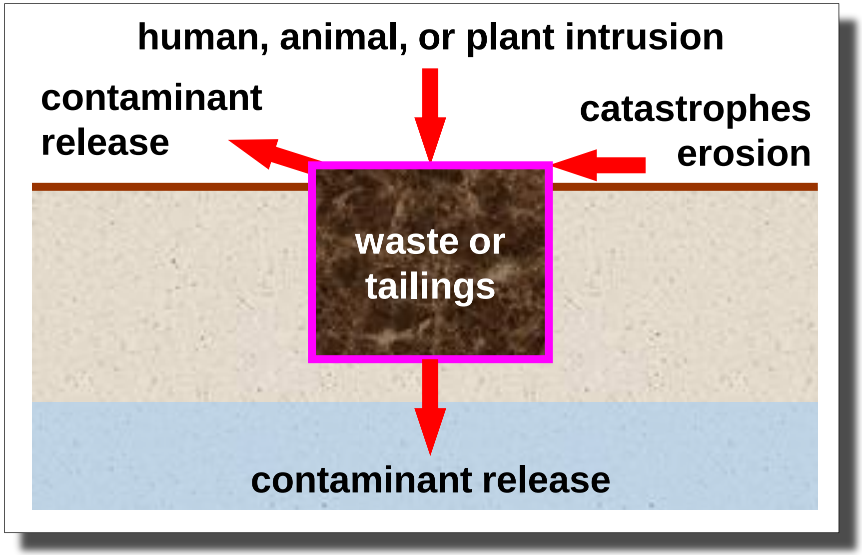
- Any man-made structure has significant amounts of potential energy stored in it
- According to the 2nd Law of Thermodynamics this energy will be dissipated unless more energy is spent to maintain the structure
- The disintegration of structures and residue management facilties will lead to the dispersal of contamination and other risks
- Decommissioning and remediation manage such risks

Decommissioning and Remediation Objectives

- Decommissioning and remediation should:
  - reduce risks to individuals or groups of individuals
  - avert such risks that are likely to arise in the future
  - prevent or reduce environmental impacts from mining and milling residues
  - not only improve the environmental situation, but also not be detrimental to other site properties
- This will be achieved by means of interventions to
  - remove existing sources of risk,
  - modify the pathways of exposure, or
  - reduce the numbers of individuals or other receptors exposed

Long-Term-Stewardship vs. Classical Engineering Paradigms

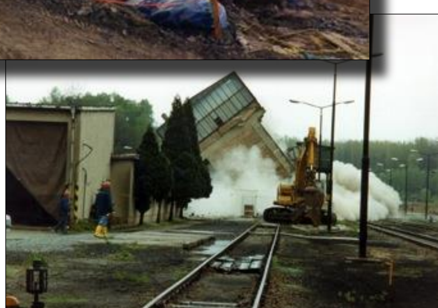
- Containment is the classical engineering paradigm in waste disposal - design for resistance
- Structures that isolate and retain mine residues require maintenance for ever
- Designs should strive to minimise the amount of potential energy stored in them

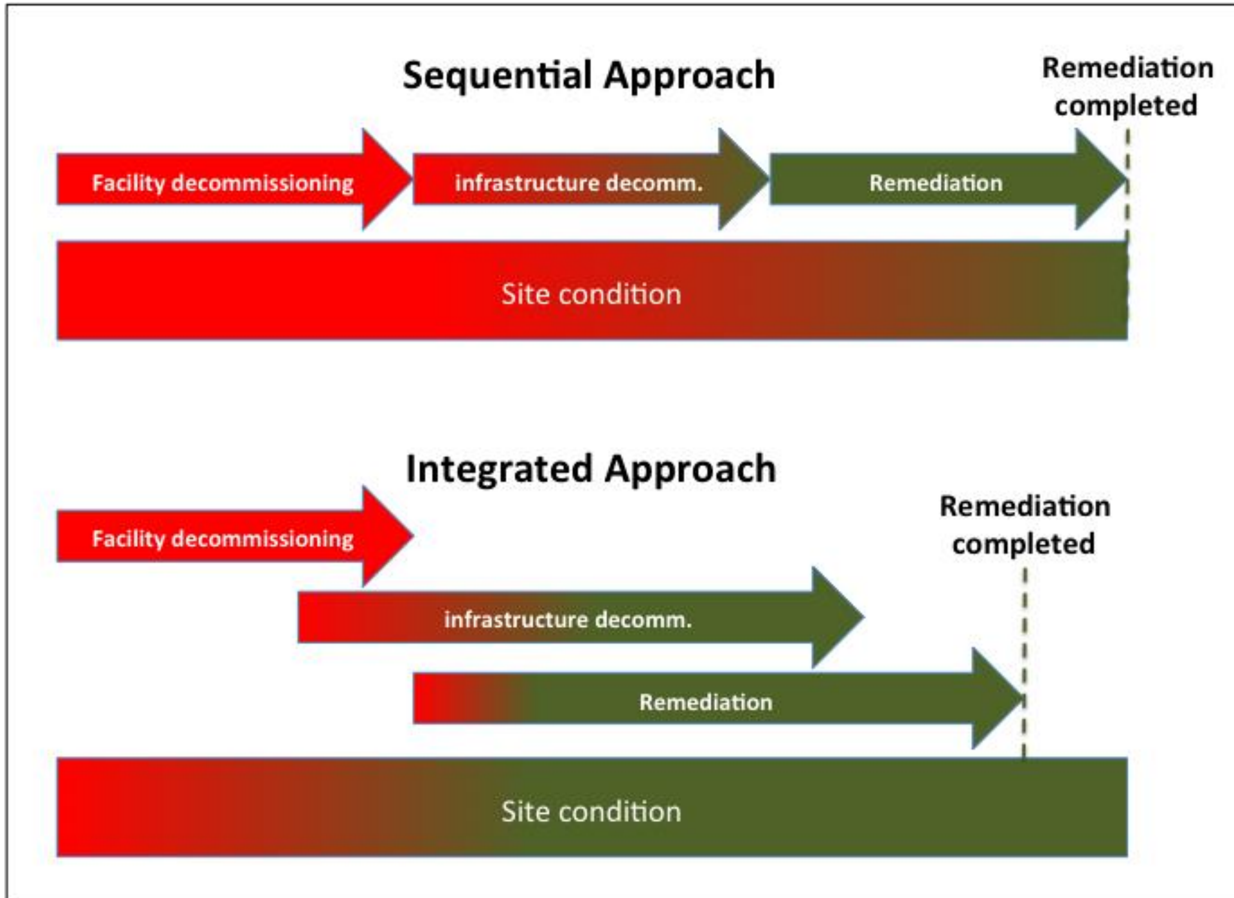


- Understanding the long-term fate of these potentials is not only an engineering task, but requires a good understanding of the long-term geological, geochemical and hydrological processes
- Adaptation to the local situation will help to extend the time horizon over which the various potentials will be dissipated

Integrating Decommissioning and Remediation

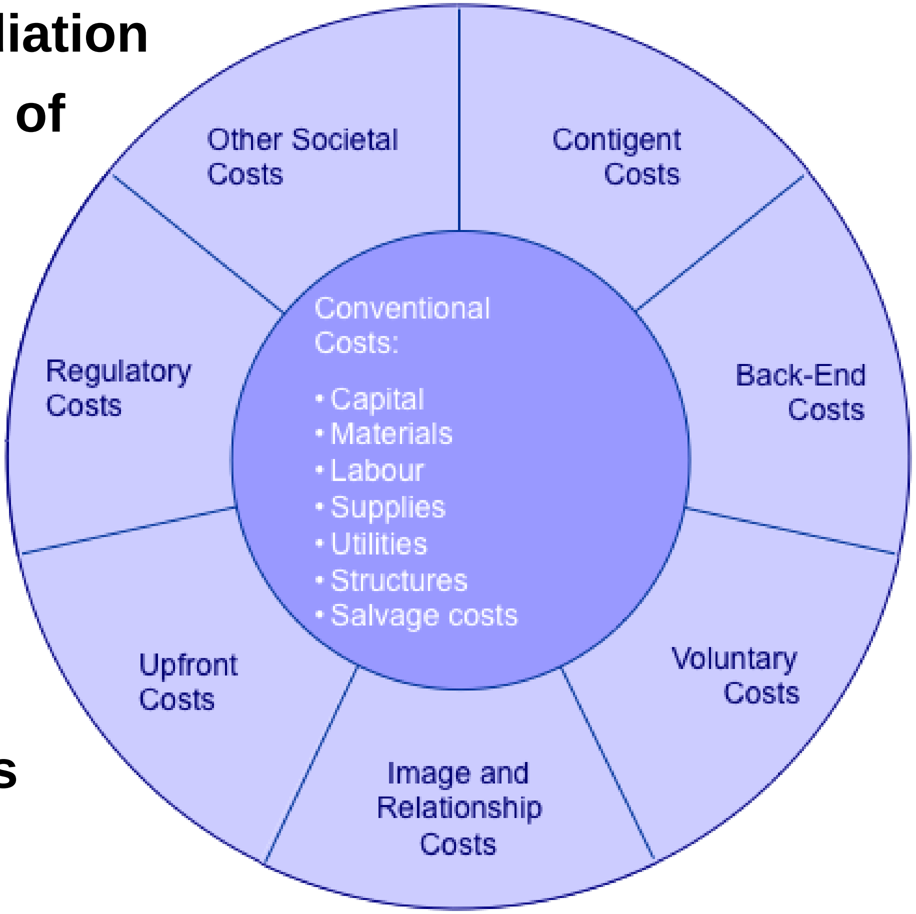
- **Integration is about creating synergies, e.g. for waste disposal, infrastructure use, and may save time**





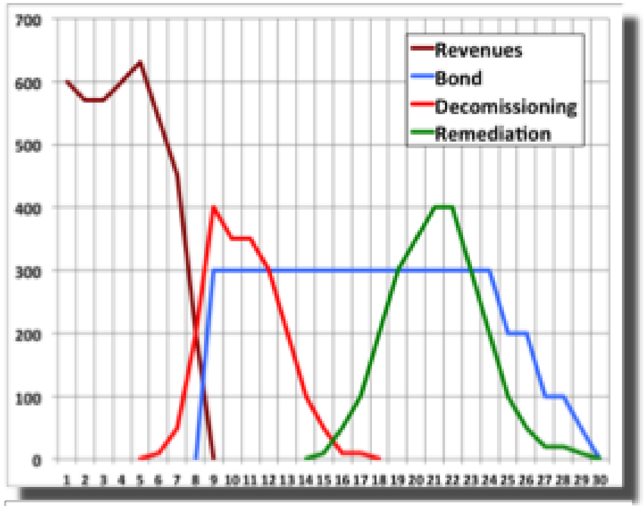
Cost Synergies

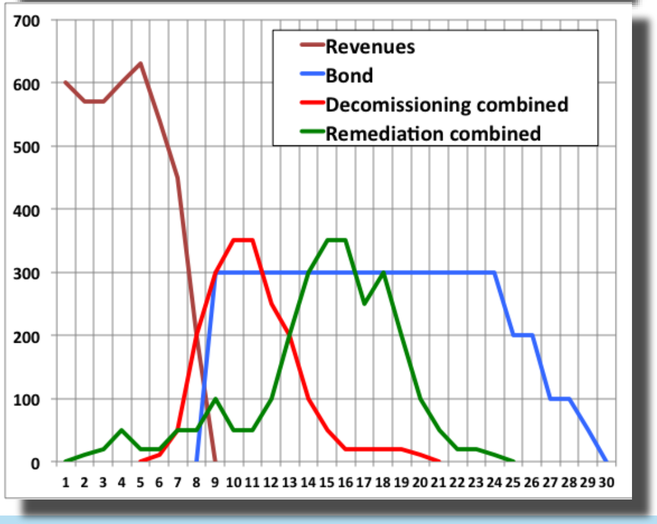
- **Decommissioning and remediation costs include a large number of variables**
- **‚Hard' costs of undertaking works and obligatory fees**
- **‚Soft' costs for e.g. SLO**
- **Integrating remediation and decommissioning is likely to result in cost savings**



Financial Synergies and Financial Risks

- The availability of funds at any one time can threaten the viability of decommissioning and remediation programmes
- The programmes may need to be tailored to the flow of moneys
- This may require to stretch out the time-scale of the programme
- (Partial) decommissioning and remediation during the operational phase reduces cost peaks and saves time





Site Re-Use: A Problem of Social Choice

- **A standard economics approach is to seek 'rational' justification for stakeholder choices between options based on preference, but**
- **Site-use options are a problem of 'social choice':**
  - **consequences of decisions have varying time profiles and may be unknown**
  - **there is uncertainty due to social indeterminacies**
  - **it will not be possible to respect all interests and perceived rights or dues**
- **Each future site use will produce different benefits, costs and risks that will be looked at differently by each stakeholder**
- **Base-line case for future site use is**
  - **return to previous use, and**
  - **unrestricted release**
- **Site-use may be pre-determined by larger-scale spatial planning, or it may be a variable in the decision making process**

Site Assessment Synergies

- Common records associated with
  - facility histories, building and land use, environmental compliance monitoring, unusual incidents
  - defining hazardous chemical inventories
  - facility drawings
- A systemic view of the decommissioning and remediation tasks as a whole will
  - facilitate overall risk management and risk reduction
  - foster confidence among stakeholders in the ability to manage the risks

Risk Management Synergies

- Risk assessment is
  - a central element of decommissioning and remediation planning to determine an acceptable end-state
  - a planning tool to identify and manage possible occupational safety and health risks to workers
  - used to design plans that minimise the risk of accidents during remediation and decommissioning
- Separate risk assessments of each activity may lead to risk ‘displacement’ by the transfer of risk to other activities, rather than overall risk reduction
- Integrating the risk across the full spectrum of the life-cycle can help to reduce the overall risk and helps to optimise closure

Materials and Waste Management Synergies

- Decommissioning may generate large amounts of wastes that can be segregated into recyclables and residual waste
- Residual waste can
  - be used in the construction of retaining structures for remediation
  - be disposed of together with mining residues
- Decommissioning scrap can be sold to industry
- Existing mine/mill infrastructure can be used, saving materials and energy for (re-)building remediation infrastructure
- Minimising the footprint during remediation/decommissioning is an additional synergy

Occupational Safety and Health Synergies

- The decommissioning and remediation operations will entail certain health and safety risks
- Health risks may result from workers being exposed to dust or hazardous chemicals during remediation or decommissioning.
- Synergies by collecting information on ecological studies, medical surveillance programmes, epidemiological or toxicological studies, regulatory requirements, and reference sources.
- Working together to design and collect necessary occupational safety and health data will also avoid duplication
- Relevant operational data may still be available during the decommissioning phase

Records Management Synergies

- Co-ordination enables new data to be collected once only, rather than several times, with only the specific job-in-hand in mind
- The sources, types of data and form of – particularly historic - data are generally disparate and the purpose of collection can be completely different for a current or future use
- The information management system should be structured so that it supports the whole life-cycle of the facility
- The data management systems should provide flexible access to cater for changing users and changing needs
- As much of the data relate to facilities or areas, access typically would be provided through a Geographical Information System

Project Management Synergies

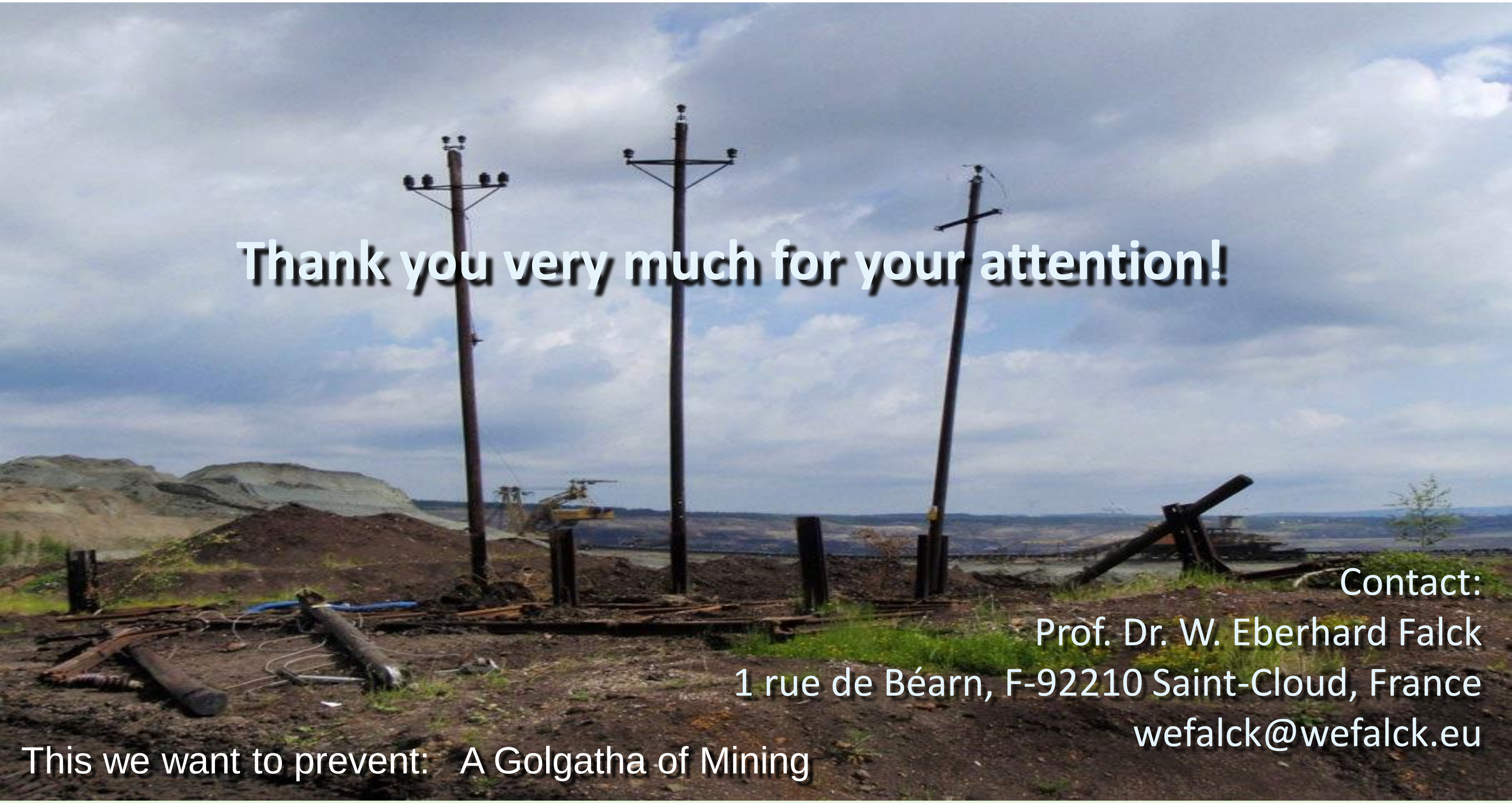
- A project management system that covers the whole life-cycle of a mine/mill should be put in place
- Integrated task planning is essential
- Co-ordination between the various tasks is a big challenge and can only be carried out from a central place with an overview
- Take time to evaluate and understand the experience of the workforce
- It is more efficient and cost effective to keep on miners and mill staff, rather than to bring in new staff
- Take advice of old plant employees, who know the site history
- Regulatory process may continue to develop, so it is critical to understand the roles of each regulatory body involved

Conclusion:
Comprehensive Mine Life-Cycle Management

- In the past the need for decommissioning and remediation often was not considered adequately -> legacies
- Move away from the ‚end-of-the-pipe' treatment paradigm
- Modern project planning for mining and milling sites covers the full life-cycle right from the start
- Life-cycle planning facilitates decommissioning and reduces the need for remediation.
- Decommissioning and remediation costs are fully internalised
- No unresolved problems are left to future generations
- The end-state of a site is understood from the beginning by all stakeholders

Exploration → Siting → Designing, construction → Operation → Decom-missioning, remediation → Final end-state → Long-term stewardship

Time



Thank you very much for your attention!

Contact:
Prof. Dr. W. Eberhard Falck
1 rue de Béarn, F-92210 Saint-Cloud, France
wefalck@wefalck.eu

This we want to prevent: A Golgatha of Mining