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Mine waste or future resource?

Integrating Industrial Ecology thinking into a mining project
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What is resource depletion?

Source: Mudd (2009)
3 out of 4 mine sites close prematurely (Laurence 2011)

- Resource is left behind
- With no planning for future use
- Resource sterilised
- Loss of jobs, local business opportunities, investments, increased environmental legacy etc.
Environmental Legacies

Mining

Ore

Mineral Processing

Concentrate

Overburden & Waste rock

25 billion tonnes/year

Tailings
A new approach to mine waste management

Viewing waste as a potential future resource...
Current practices

Open pit and/or underground operations

Pit lake

Waste dump stock piles

Tailings impoundment

Low-grade ore

Very low-grade ore

Contamination pathways

Metal recovery

Impermeable base for long-term collection of pregnant liquor solution

Dold (2008)
... Integrated across the mine’s life cycle

- Increased resource recovery
- Increased resilience

Dold (2008)
Sustainable resource extraction

I_3 < I_1 + I_2

Traditional resource extraction

P_1 + P_2

Re-mining

P_1

Resource recovery (P_1 + P_2)/R

Case A

Mine X

Traditional resource extraction

Environmental Impact I_1

Production P_1

Re-mining

I_1

P_1

Resource recovery (P_1 + P_2)/R

Case B

Mine X

Traditional resource extraction

Re-mining

I_2

P_2

Resource recovery (P_1 + P_2)/R

Case C

Mine X

‘Sustainable’ resource extraction

I_3 < I_1 + I_2

P_1 + P_2

I_2

P_2

I_1

P_1

P_2 + P_1 \geq \frac{P_1}{I_2 + I_1}
The framework

• A Life Cycle Analysis (LCA) to measure the benefits of waste re-processing (case A & B)

• A qualitative investigation of internal and external factors to promote change (case C)
Life Cycle Analysis system definition

System boundaries for traditional mineral production

Mining

Mineral Processing

Metal concentrate

FU

System boundaries for mine waste re-processing

Waste Re-mining

Mineral Processing

Metal concentrate

FU

Overburden & Waste rock

Tailings

Little or no Overburden

More benign Tailings
The framework

• A Life Cycle Analysis (LCA) to measure the benefits of waste re-processing (case A&B)

• A qualitative investigation of internal and external factors to promote change (case C)