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sustainability consulting + software

Influence diagrams and scoping

for Life Cycle and Sustainability Assessment

an example from sustainable mining

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Influence diagrams and scoping for LCA and Sustainability Assessment

1. A motivation
2. Influence diagrams
3. Influence diagrams for life cycle sustainability assessment of a mining site and mining technology
4. How to use the diagrams, scoping
5. Status and outlook

1 A motivation

Why influence diagrams?

- LCA is an established, standardised, “science-based” approach for holistically assessing environmental and potentially other impacts over the life cycle of a product or service:

“LCA considers all attributes or aspects of natural environment, human health and resources. By considering all attributes and aspects within one study in a cross-media perspective, potential trade-offs can be identified and assessed. “
ISO 14040 2006, 4.1.7, comprehensiveness

→ LCA is a very useful approach for understanding sustainability impacts of mining.

Why influence diagrams?

- However,
  - level of detail of the LCA set by goal and scope; expert knowledge, guessing, and study conditions are common for specifying goal and scope
  - LCA is a linear model -> feedback loops hard to detect (e.g.)
  - uncertainty, lack of knowledge prevail for some products: GMO, nanotech-products, mine-site products

Why influence diagrams?

→ LCA by design “does not see everything” (linear, typically deterministic model)

→ The extent can be further reduced by goal and scope settings

→ Influence diagrams, established before starting the LCA modelling, are a way to

  → identify the toolset needed for a comprehensive understanding of a problem

  → identify relevant and irrelevant aspects for a life cycle model

2 Influence diagrams

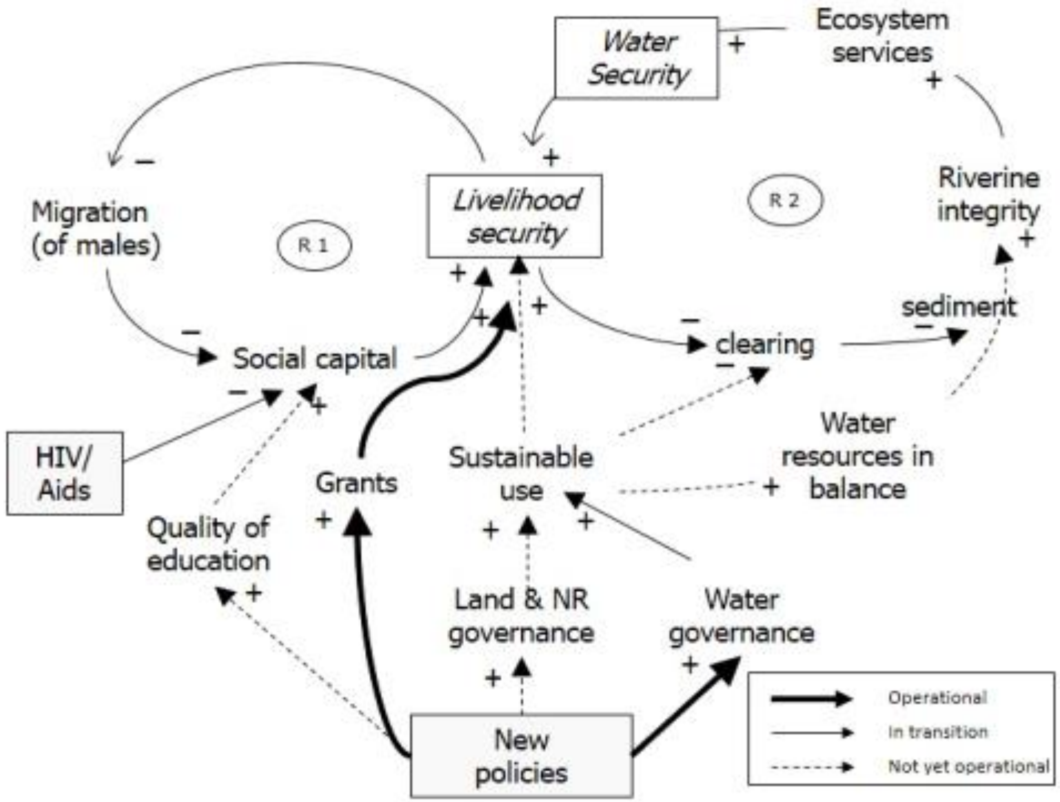
Influence diagrams, an introduction

Influence diagrams / causal loop diagrams are visual diagrams about a situation or issue, with longer tradition in modelling[1] :

- variables are connected with arrows, showing relations between variables
- arrows have an indication of whether the relation is enforcing (+, more creates more) or the opposite (-, more creates less)
- qualitative modelling, unrestricted

[1] e.g. Bossel, H.: Modellbildung und Simulation, Kassel 1994

Influence diagrams, an introduction, 2
Effects of policy decisions on livelihood and water security, Pollard et al 2014



Pollard, S., H. Biggs, and D. R. Du Toit. 2014: A systemic framework for context-based decision making in natural resource management, Ecology and society 19(2): 63

Influence diagrams, an introduction, 3

Steps to create the diagram

- identify the variables
- identify the causes and relations
- add the direction of the cause, a ‘+’ indicating increase, a ‘-‘ decrease
- check that only direct relations are represented
- check that all other relations are frozen when one relation is considered
- clearly define the state and starting point for the diagram

3 Influence diagrams for life cycle sustainability assessment of a mining site & technology

Influence diagrams for mining

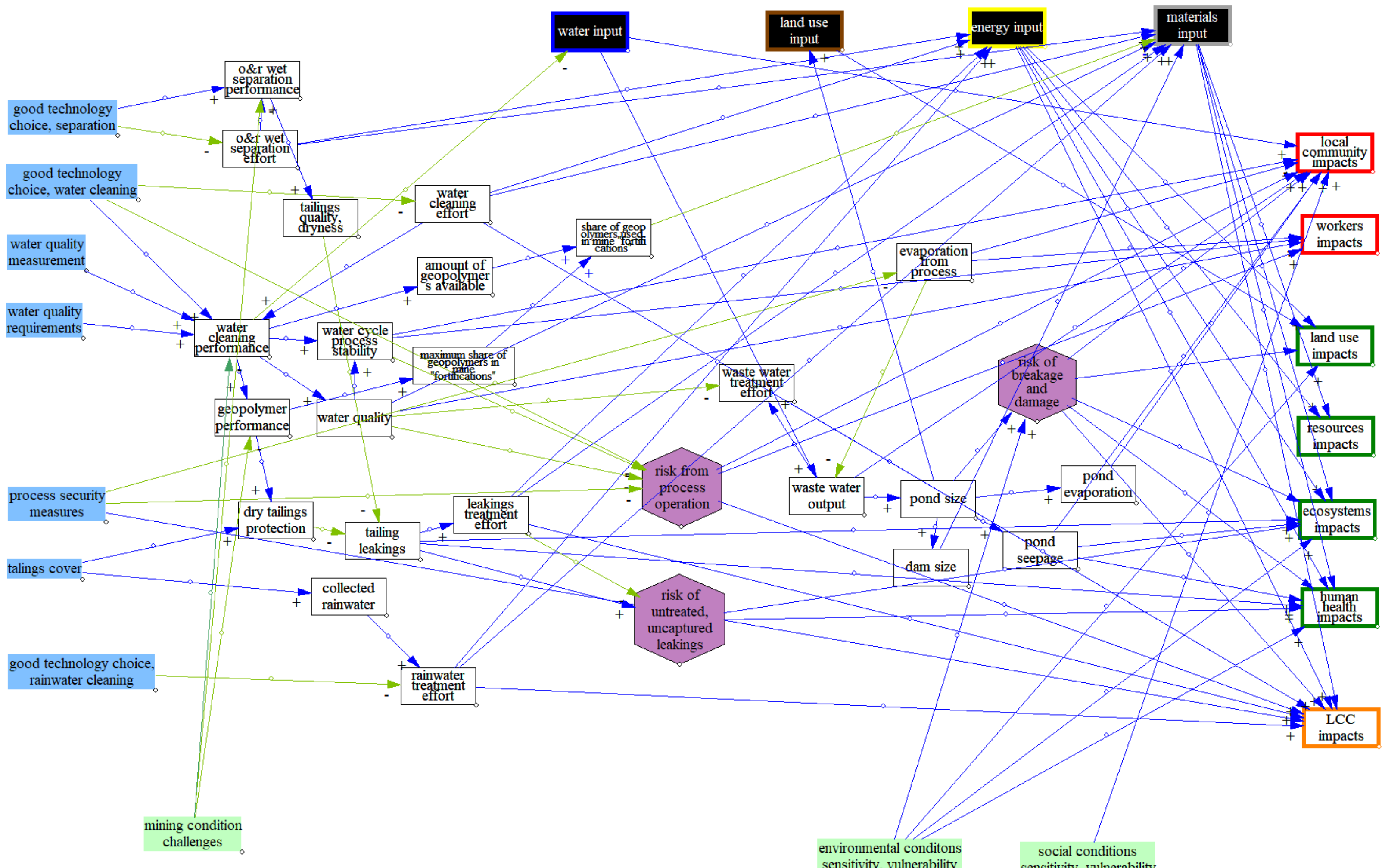
Iterams, EU H2020 project, 2017-2021, www.iterams.eu:

a new, innovative technology is proposed and tested which promises to reduce water input and output flows of a mine and produces „concrete-like“ material from mining residues, to be used within the mine

Tested in mine sites, e.g. for copper, in Finland, Portugal, South Africa

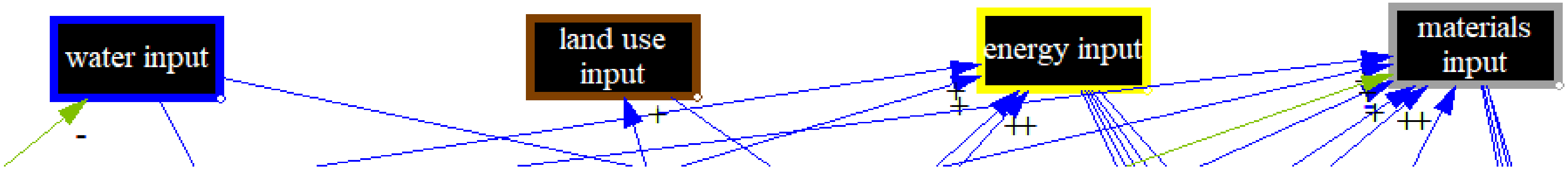
→ is this new technology more sustainable, over the life cycle?

Influence diagrams for mining: Iterams

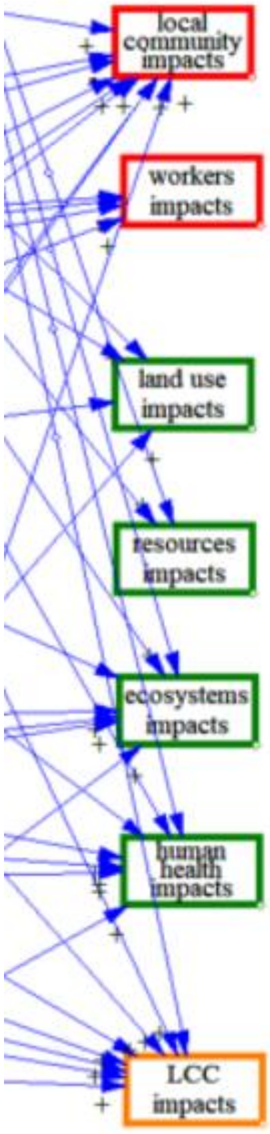


Influence diagrams for mining: Iterams

Inputs: water, land use, energy, materials -> link to life cycle



Influence diagrams for mining: Iterams
Impacts on sustainability

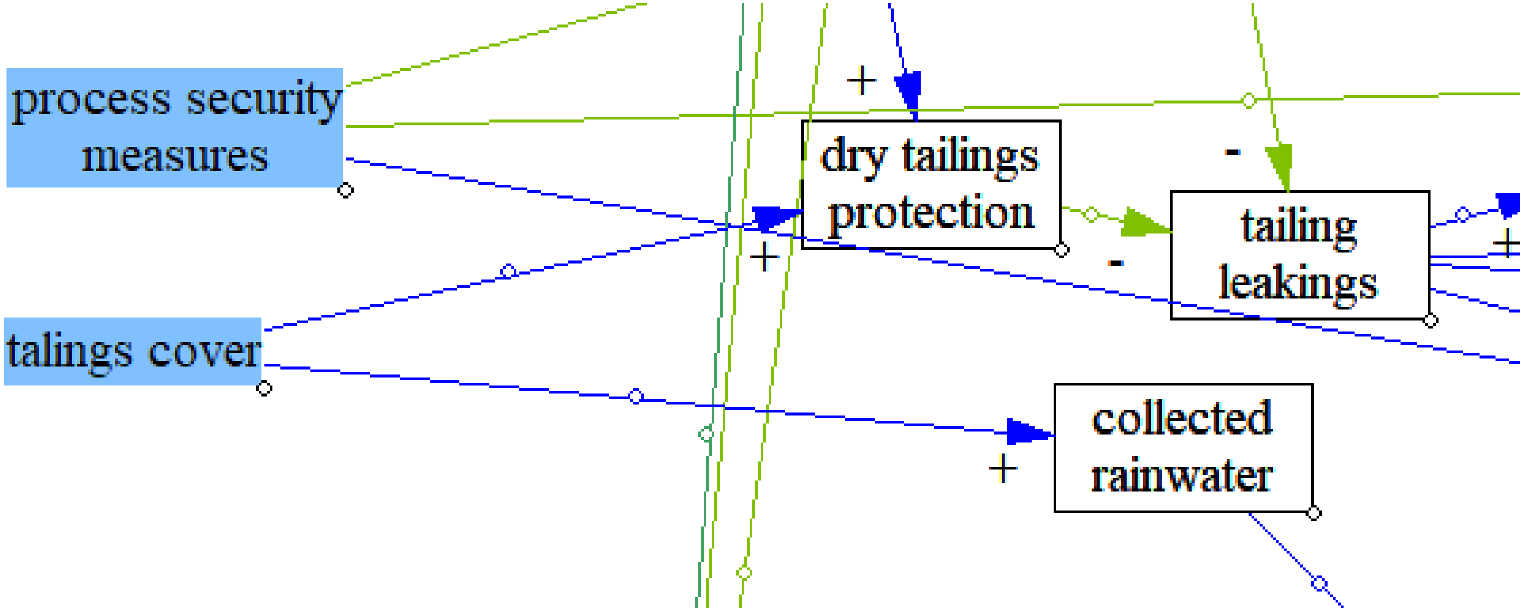


Influence diagrams for mining: Iterams
Other elements

Relations, and status variables

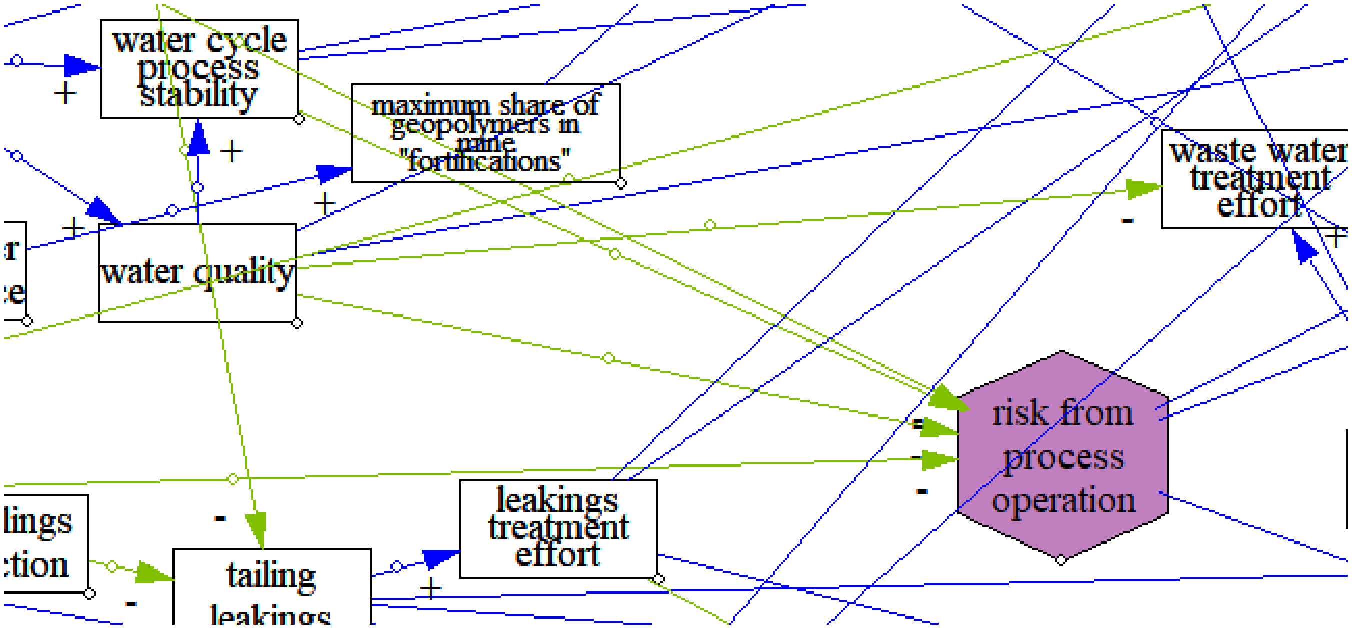
Influence diagrams for mining: Iterams
Other elements

External variables



Influence diagrams for mining: Iterams
Other elements

Risks

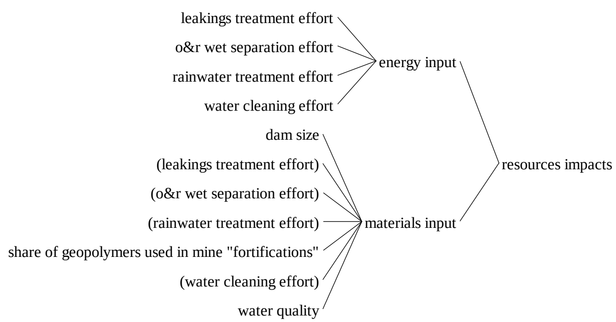


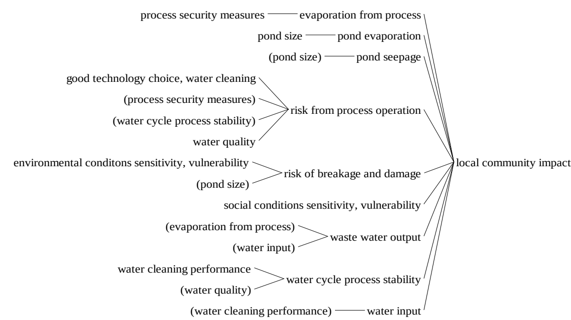
4 How to use the influence diagrams

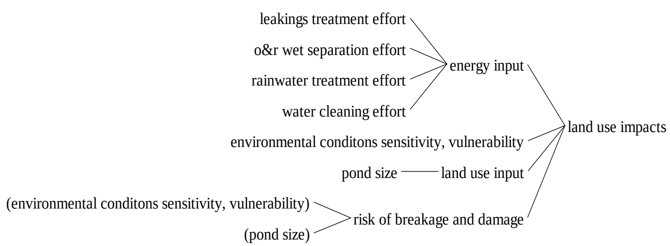
How to use the diagrams

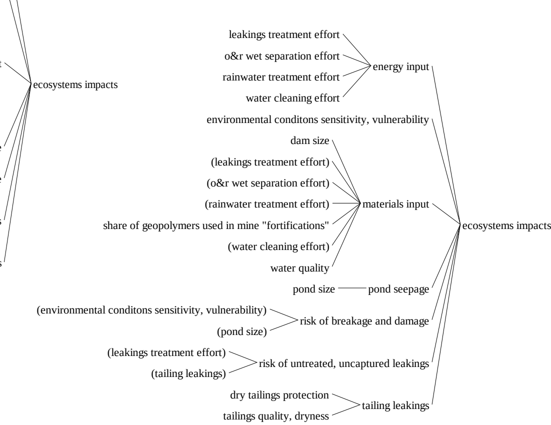
- Visualise and discuss relations
- Find hot spots and trade-offs
- Determine goal and scope for LCA (extended)

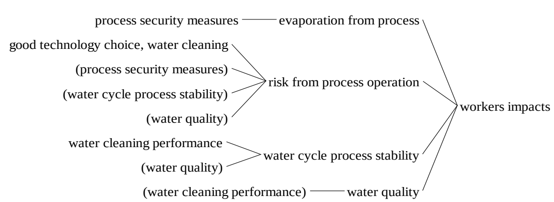
How to use the diagrams: hot spots and trade-offs



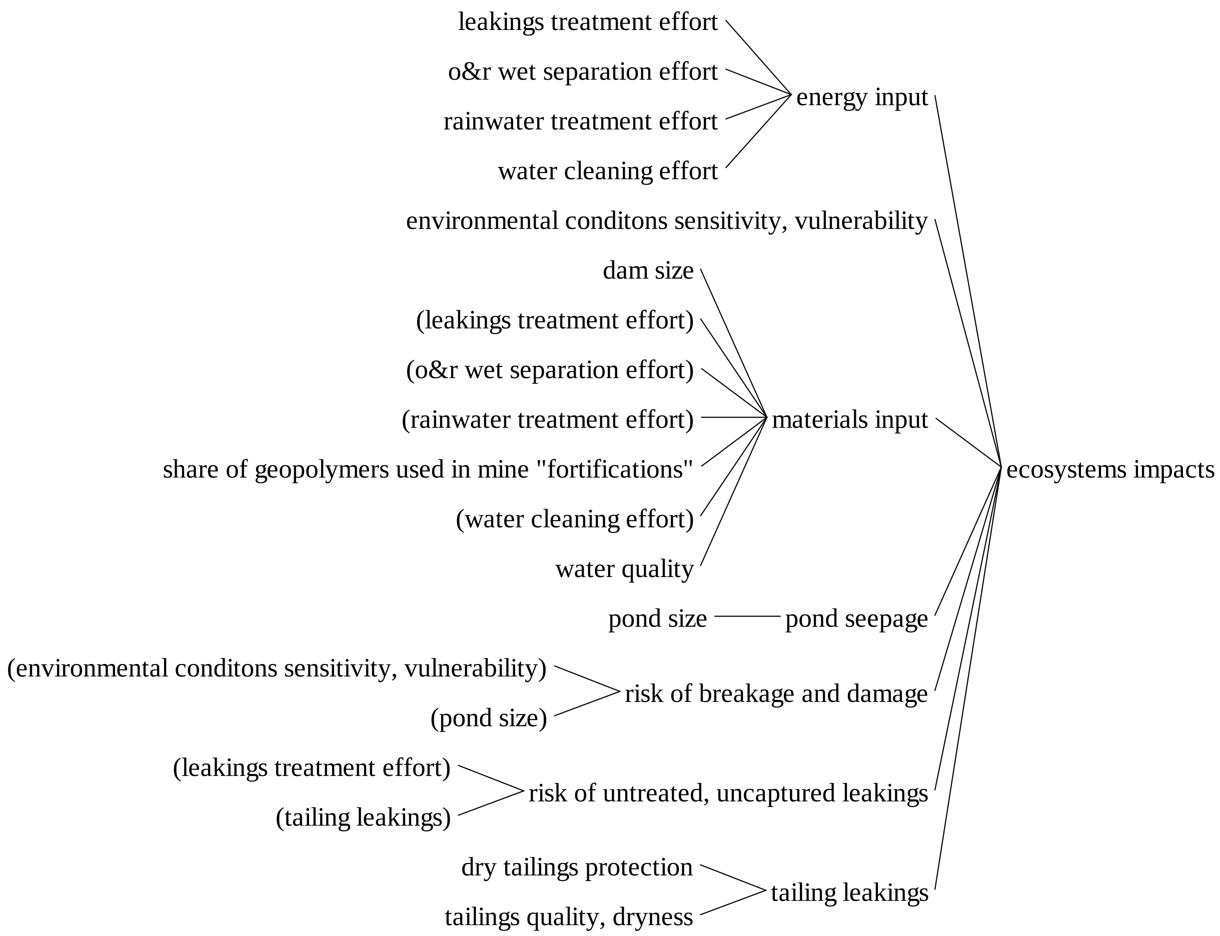




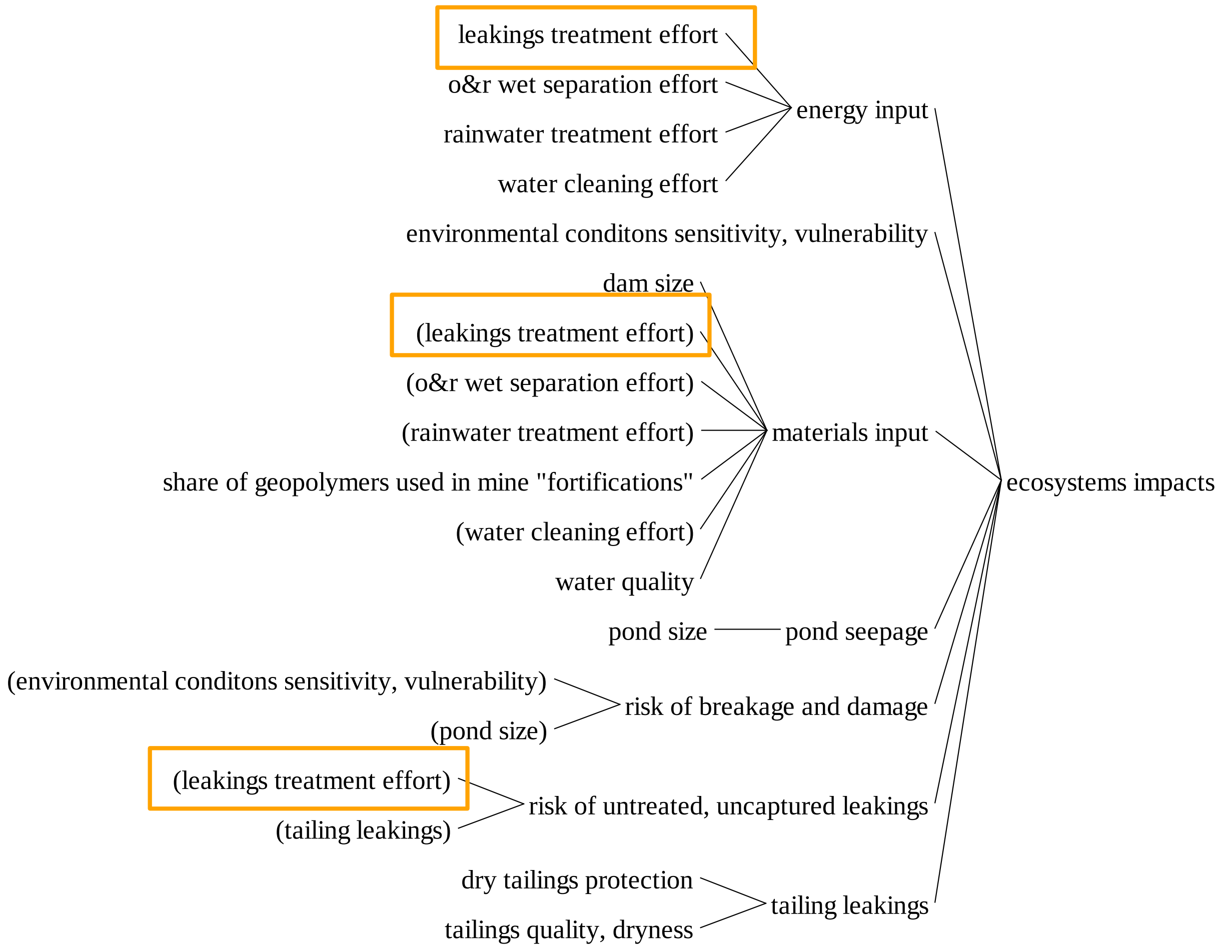




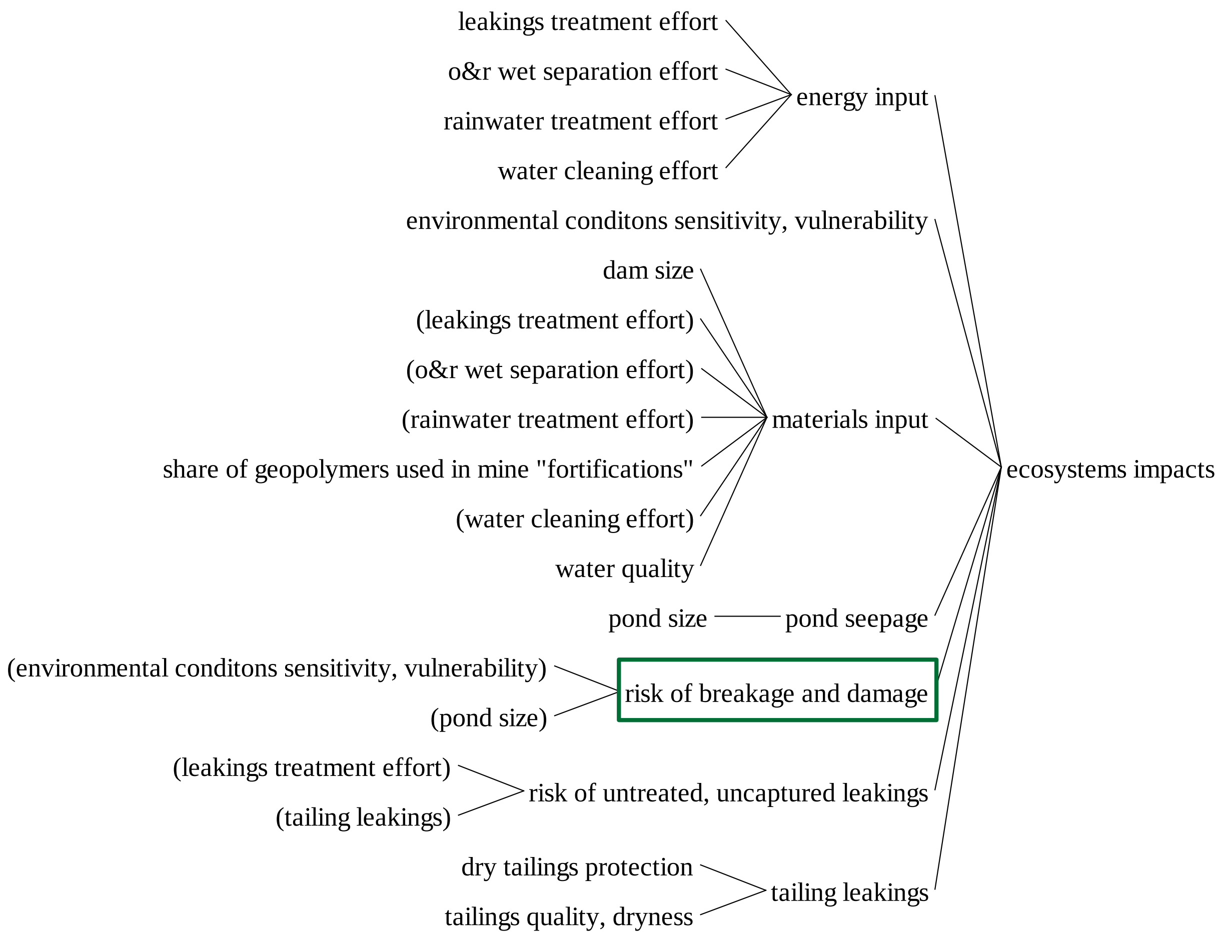
How to use the diagrams: hot spots and trade-offs



How to use the diagrams: hot spots and trade-offs



How to use the diagrams: goal and scope



5 Conclusions

Conclusions

- Influence / causal loop diagrams are a good way to show and „get into“ the topic of an extended LCA study
- Easy to build, no method- or toolbased limitations
- Purposes
  - display relations
  - Identify hot spots and trade offs
  - structure and motivate goal and scope

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Thank you!

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