How to improve impact assessment for metal mining?; illustrated with a land use biodiversity IA method for LCA

TNO Industrial Technology

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Centre for Chain Analysis and Environment

- TNO & CML
- complicated life cycle studies for decision support
- eco-efficiency studies
- substance flow analyses

=> extensive study on land use and desiccation in LCA

Possible issues at stake in metalmining

Within LCA:

- Resource depletion/competition
- Land competition
- Desiccation impacts
- Noise and dust impacts
- Fuelexhaust and other chemicals emission impacts
- Land occupation and -transformation impacts
- ?

Outside of LCA?

- Risk of accidents
- Impacts on social& culturalstructures
- ?

Where to start improving LCA for mining?

Within impact assessment?

- Skip impact categories?
- Add impact categories?
- Change impact indicators?
- Provide a model to simplify interpretation?

Within the inventory?

- Complete global data sets for all metals?
- Improve existing major data sets?

Why improve at all?
Case: land use LCIA method

* Discussion on existing methodology:
  - indicators
  - reference level

* Integration of new data:
  - LCA species density data for many land use types (Koellner)
  - Global reference data on species density (Barthlott et al.)
  - Global ecosystem - biome-model data (Leemans et al.)

* Global ecosystem level factors proposed (Weidema, 2001)

* Opportunity due to Delft Cluster (DC) programme & RWS DWW

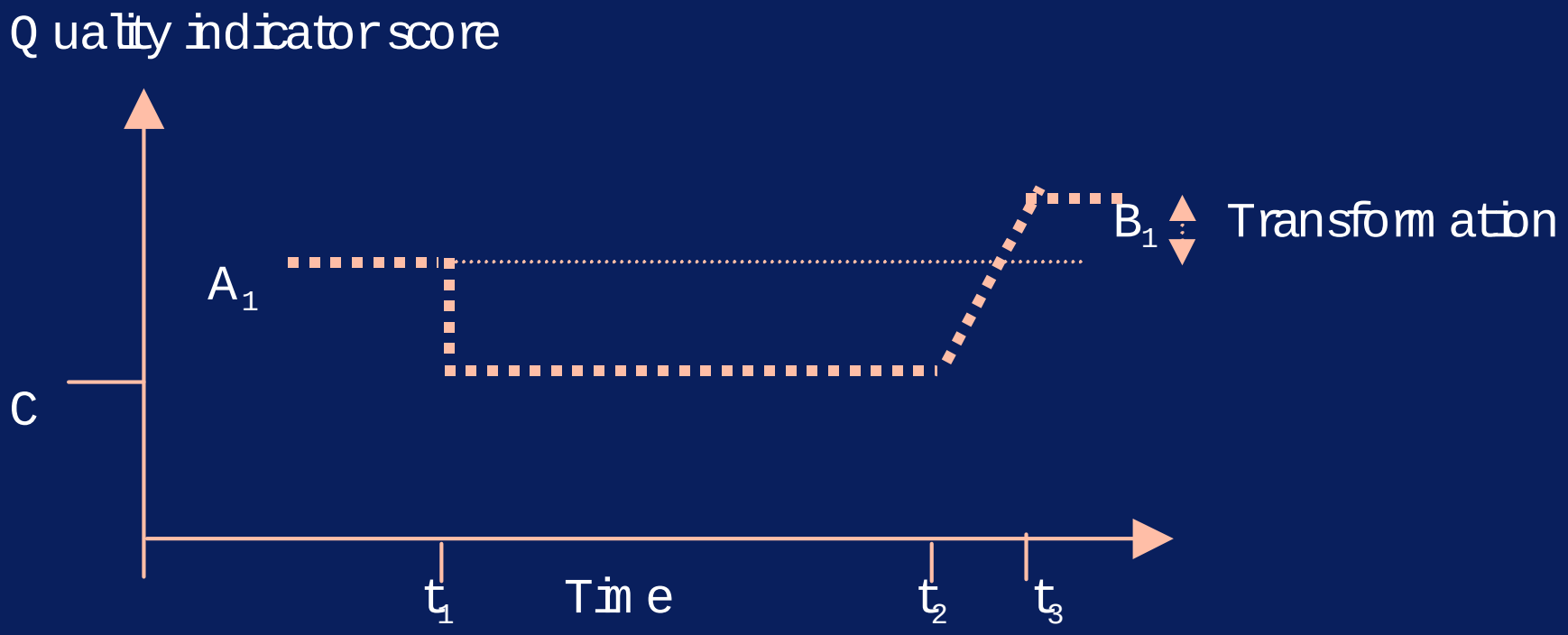
Illustrating improvements with a land use LCIA

An LCIA developers dilemma

1. Land competition, land occupation or land transformation?
2. Which impact indicators for biodiversity & life support?
3. Include which reference state as baseline?
4. How detailed regional differentiation?
5. How to attribute transformation and renaturation?

Ad 1: Including transformation

Transformation = A x change in quality



Ad 2: Which biodiversity indicators?

- Ecosystem Occupation

$$EO = A \times t \times SD_{i,ref} \times ES_i \times EV_i \times EQ_i$$

- Ecosystem Transformation

$$ET = A \times \Delta SD_{i,ini} \times ES_i \times EV_i \times EQ_i$$

(for each biome i)

- local plant species diversity (SD_i)
- global ecosystem scarcity (ES_i)
- global ecosystem vulnerability (EV_i)
- global ecosystem quality (EQ_i)

Ad 2: which biodiversity indicators?

local species level

Occupation:

- $SD_{i,ref} = 1 - (S_{act}^{0.01} / S_{ref}^{0.01})$

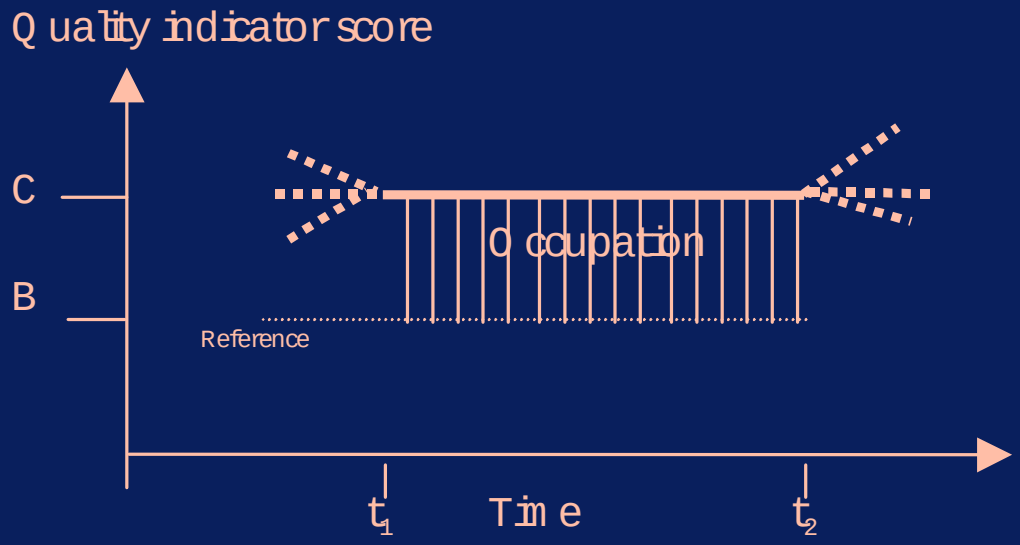
Transformation:

- $\Delta SD = 1 - (S_{fin}^{0.01} / S_{ini}^{0.01})$

Ad 3: Occupation reference state

Occupation = A x t x quality indicator

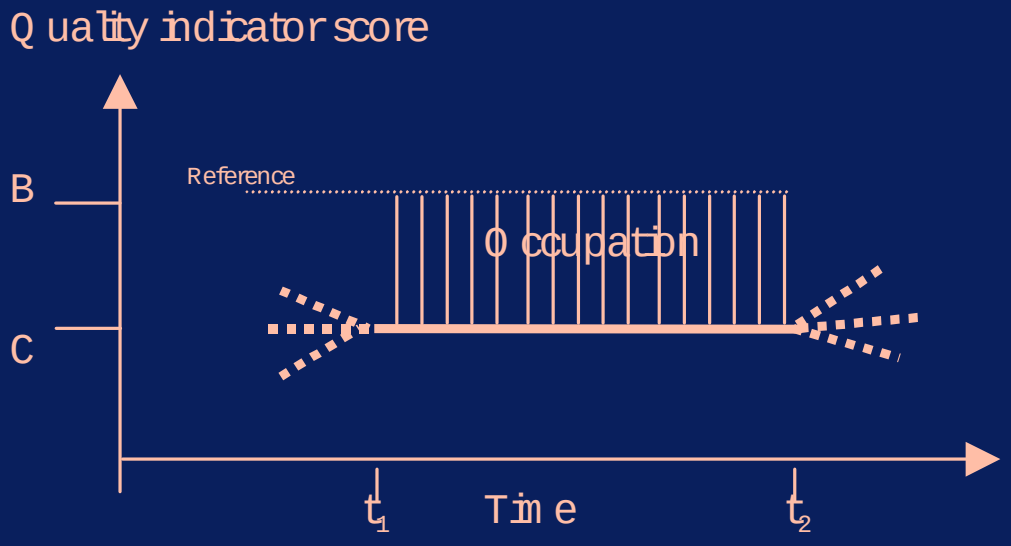
Occupation with AVERAGE reference



Ad 3: Occupation reference state

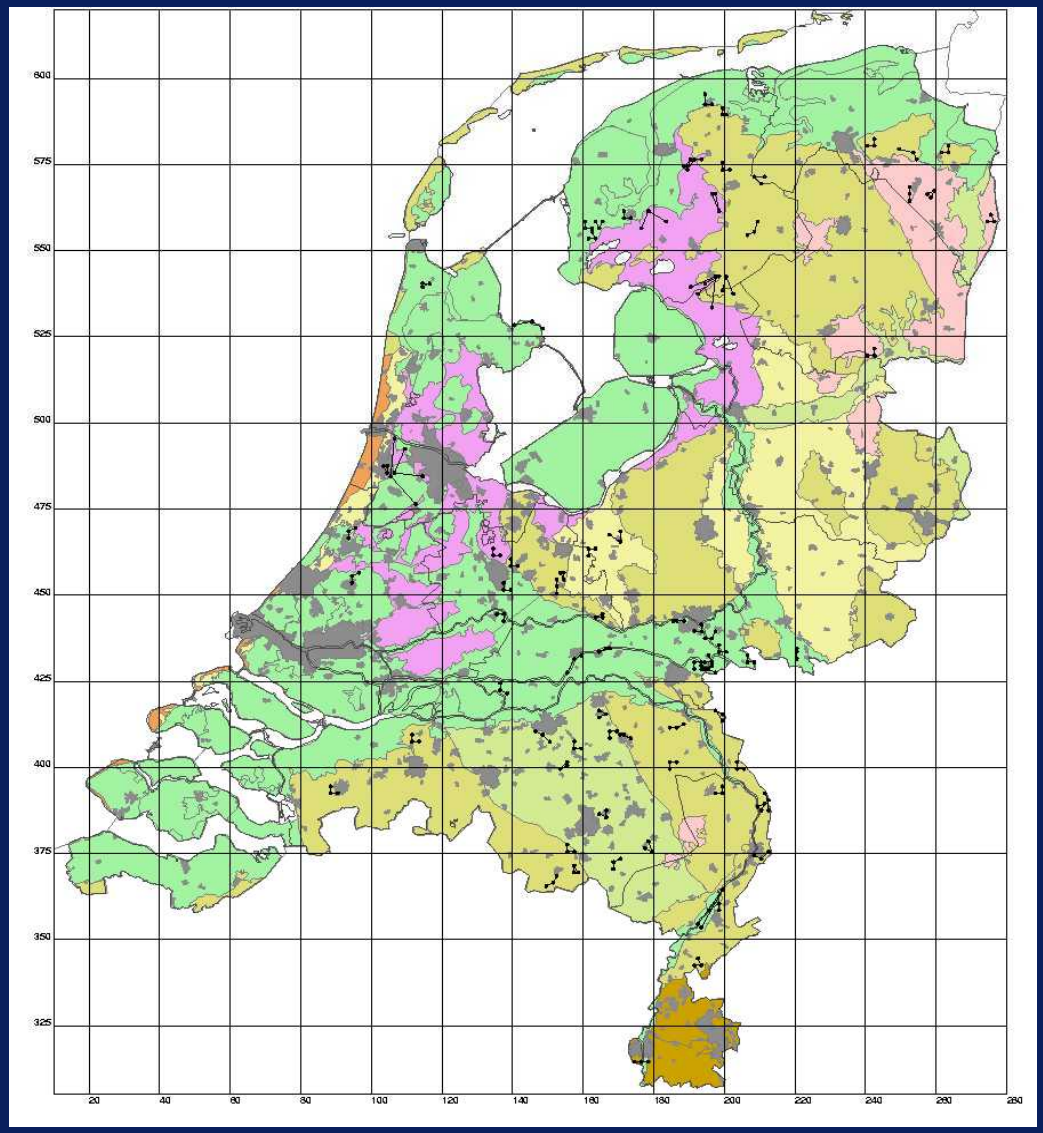
Occupation = A x t x quality indicator

Occupation with MAXIMUM reference

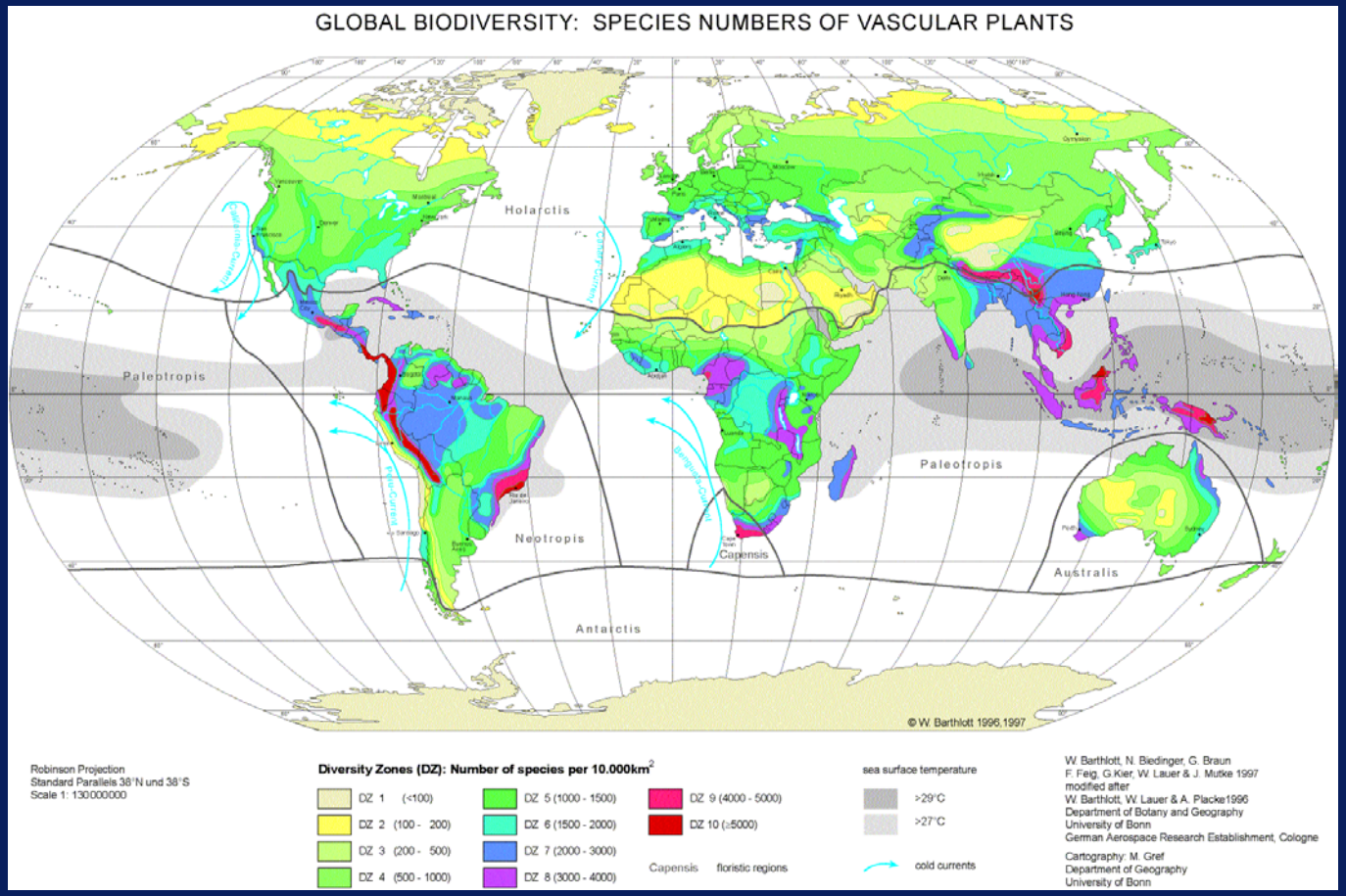


Ad 4: data collection for aggregate extraction

- Floron database: quantitative data on plant species per km^2
- 5 types of aggregate, 7 types of indicator
- Expert judgements from Ark Foundation on plant species per $0.1\ km^2$



Ad 4: Global impact assessment data: species diversity (Barthlott et al.)



Ad 4: Global impact assessment data:

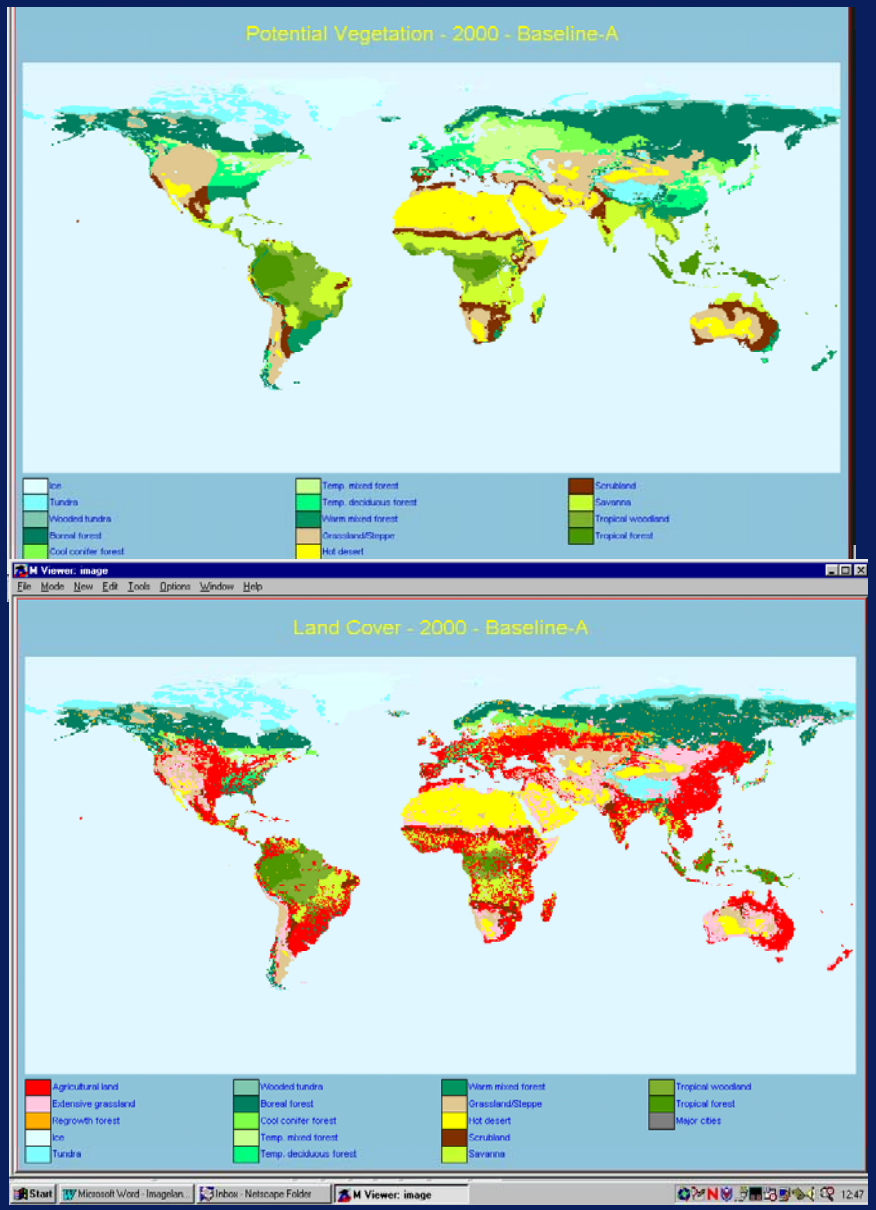
potential

&

actual

biome area's

(Leemans et al.)



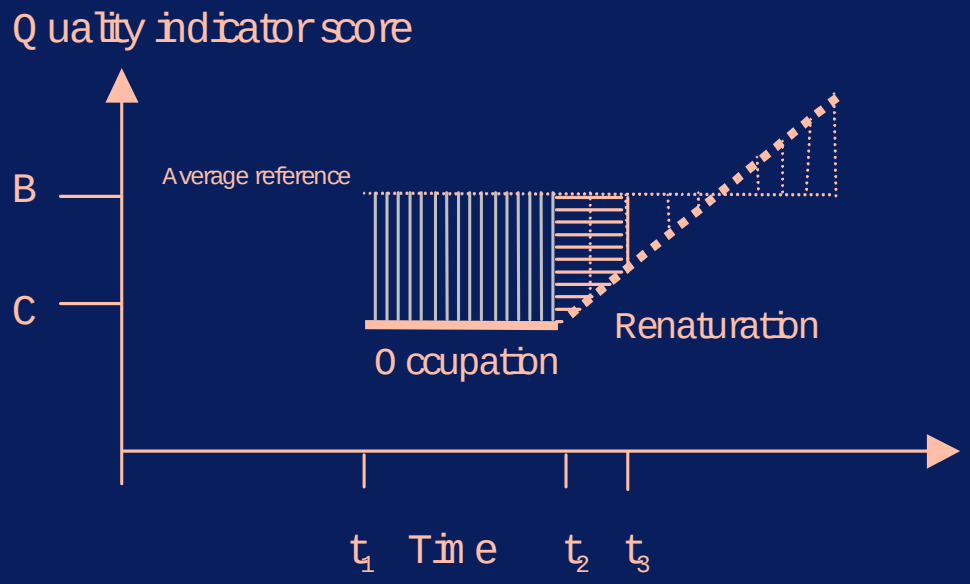
UIT IMAGE 2.1

Ad 4: Consequence of no regional differentiation

Extraction	Occupation (m2.y/t)	SDxESxEV for 2 regions		Factor increase in range
• Iron	0.11	2-6	93-278	15-140
• Uranium	0.1 – 4	2-6	130-174	22-87

Ad 5: How to attribute renaturation time?

Occupation during renaturation (with different modelling horizons t_3)



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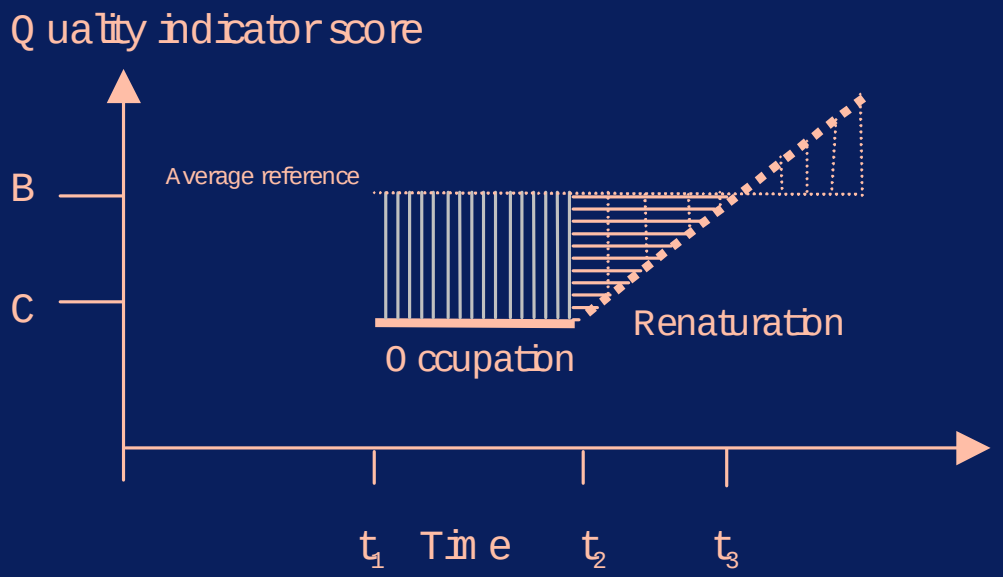

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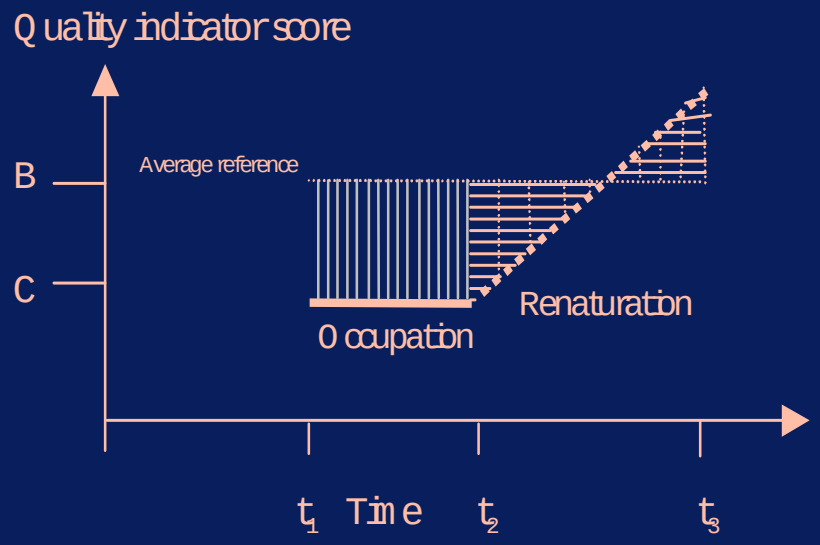
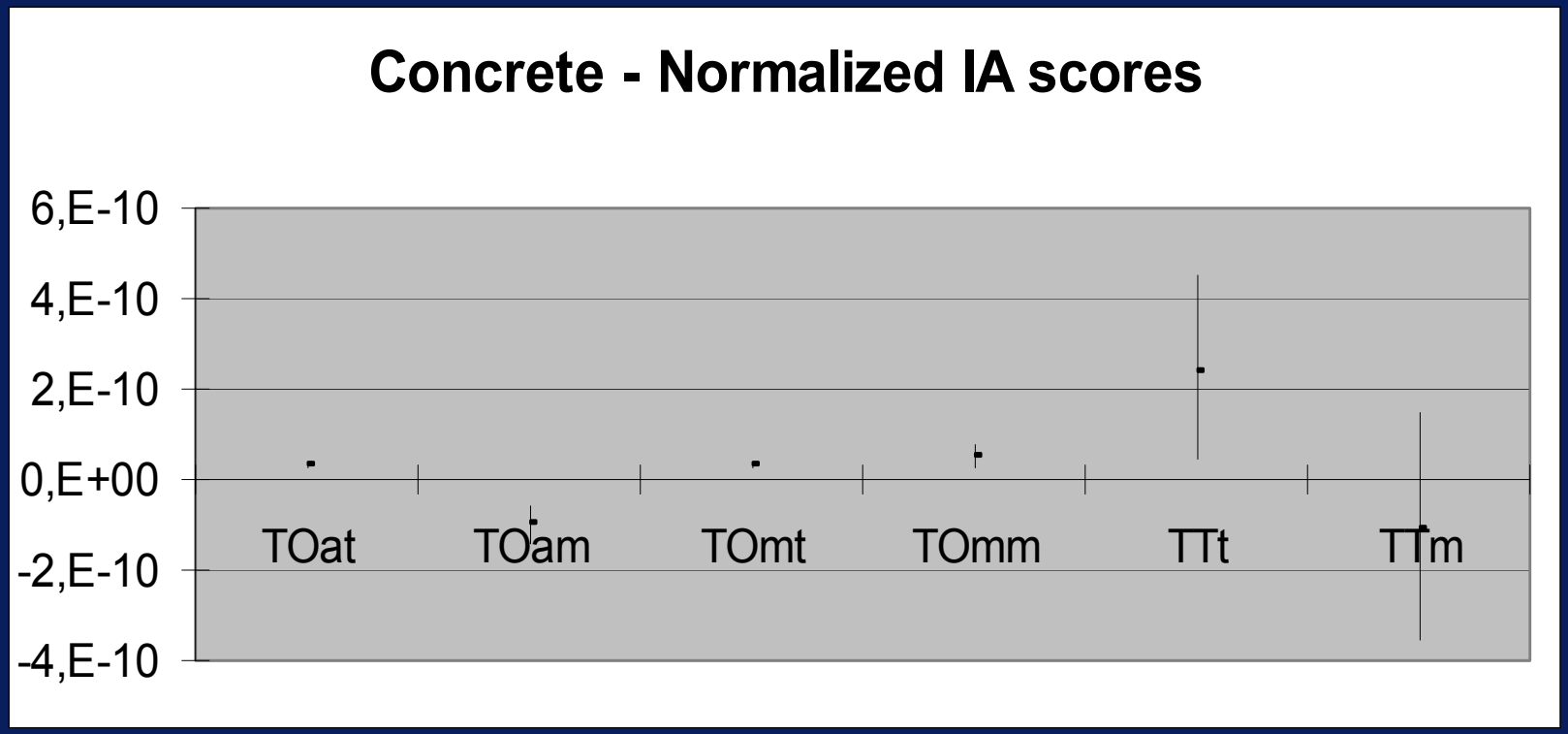


Ad 1,3,5: Case concrete outer wall: results biodiversity



TO = total occupation a = average ref. t = traditional (no renat)

TT = total transformation m = maximum ref. m = modern (renaturation)

Uncertainty estimates only for impact assessment!

Requirements of the method for inventory data

- Separate occupation and transformation
- Separate the renaturation part of occupation
- Differentiate at least between regions in continents
- Uniform and specific nomenclature:
  - -Occup landuse_type [specif.][region] m2.y
  - -Renat landuse_type [specif.]class$_1$-class$_2$ [region]m2.y
  - -Trans landuse_type [specif.]class$_1$-class$_2$ [region]m2
  - -Trare landuse_type [specif.]class$_1$-class$_2$ [region]m2
- Implement impact assessment method in software

Specifying the original questions

- How much impact information is desired, and by whom?
- How far can and should mining locations be specified?
- What precision is possible and desirable?
- Who decides how far to go, and who ensures consistency?

Some requirements for answers

- An overview of major use(r) groups
- Realise requirements of LCIA methods
- Realise limitations of LCIA methods
- Steering the process of LCIA development

Conclusions

- Mining industry:
  - Understand implications of LCA methodology
- LCA community:
  - Understand policy issues
    - Decide on including them
- UNEP Life Cycle Initiative:
  - Harmonisation or improvement?
    - Priority setting procedure required
      - Help to build the bigger picture