Impact assessment of abiotic resources: the role of borrowing and dissipative resource use

Rolf Frischknecht
treeze Ltd., Uster
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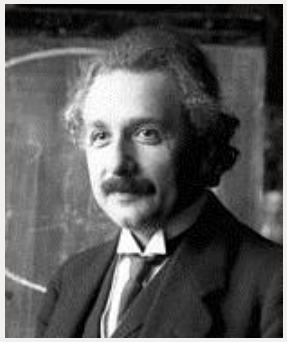
Problem setting

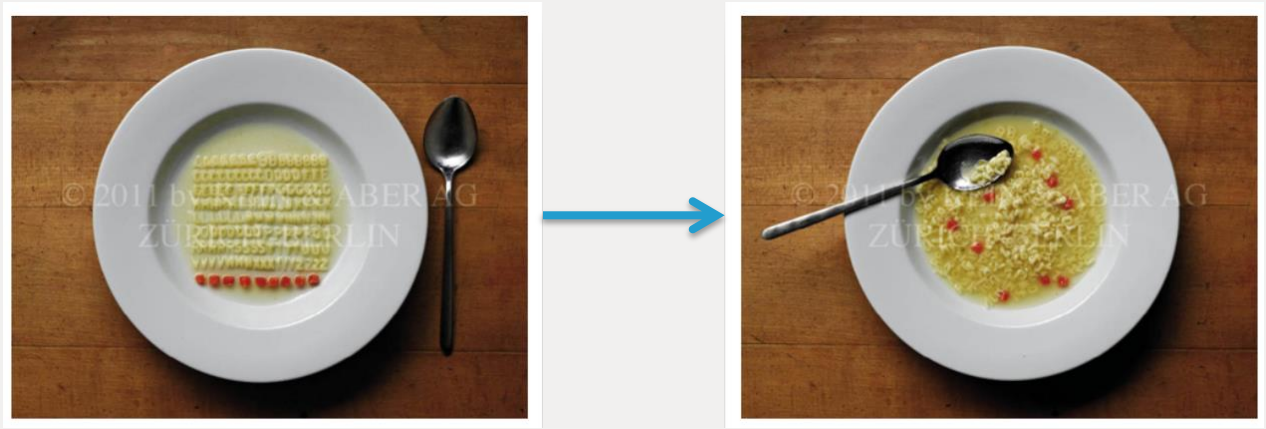
- Material resources cannot be lost (on earth), except for
  - Conversion to energy
    Nuclear fission
    $E = m * c^2$



  - One way missions to the universe

Problem setting (cont.)

- Material resources may be dispersed
- Second law of Thermodynamics:
  Entropy (measure of disorder) tends to a maximum in closed systems



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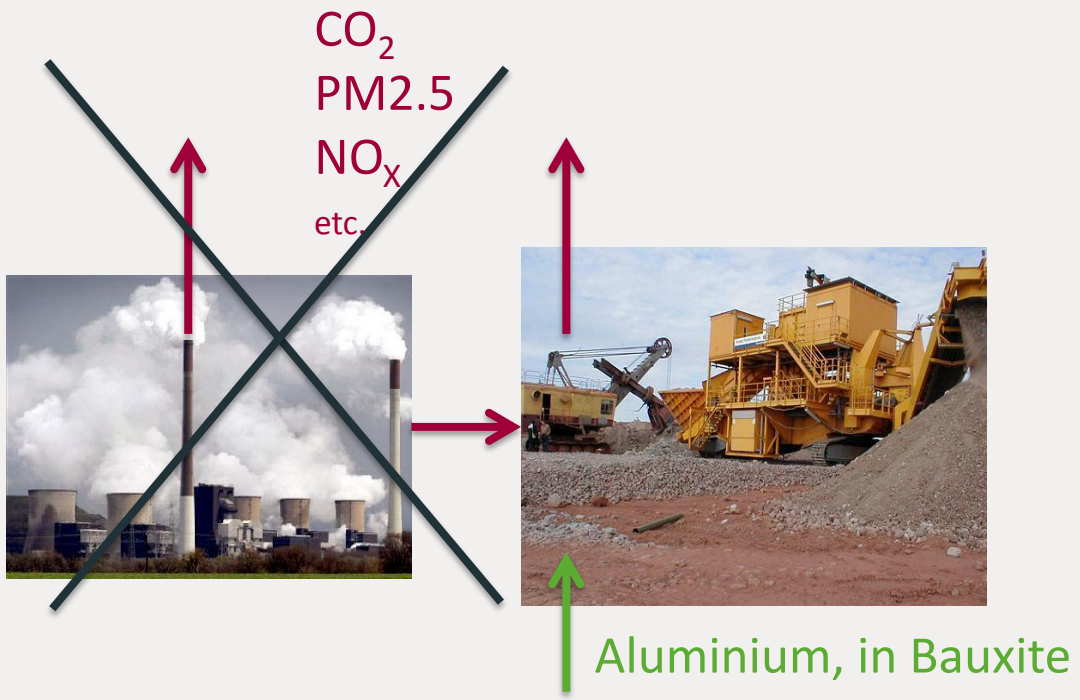
Research question

- Premise:
  - Resources are a safeguard subject on their own
  - Resources have an intrinsic value
- What is the appropriate resource flow to be assessed in the impact assessment?

Terminology and scope: Resource impact factor

- Impact factor of the resource itself
- Does NOT include impacts caused by
  - electricity demand
  - fuel supply and combustion
  - process emissions

during resource extraction



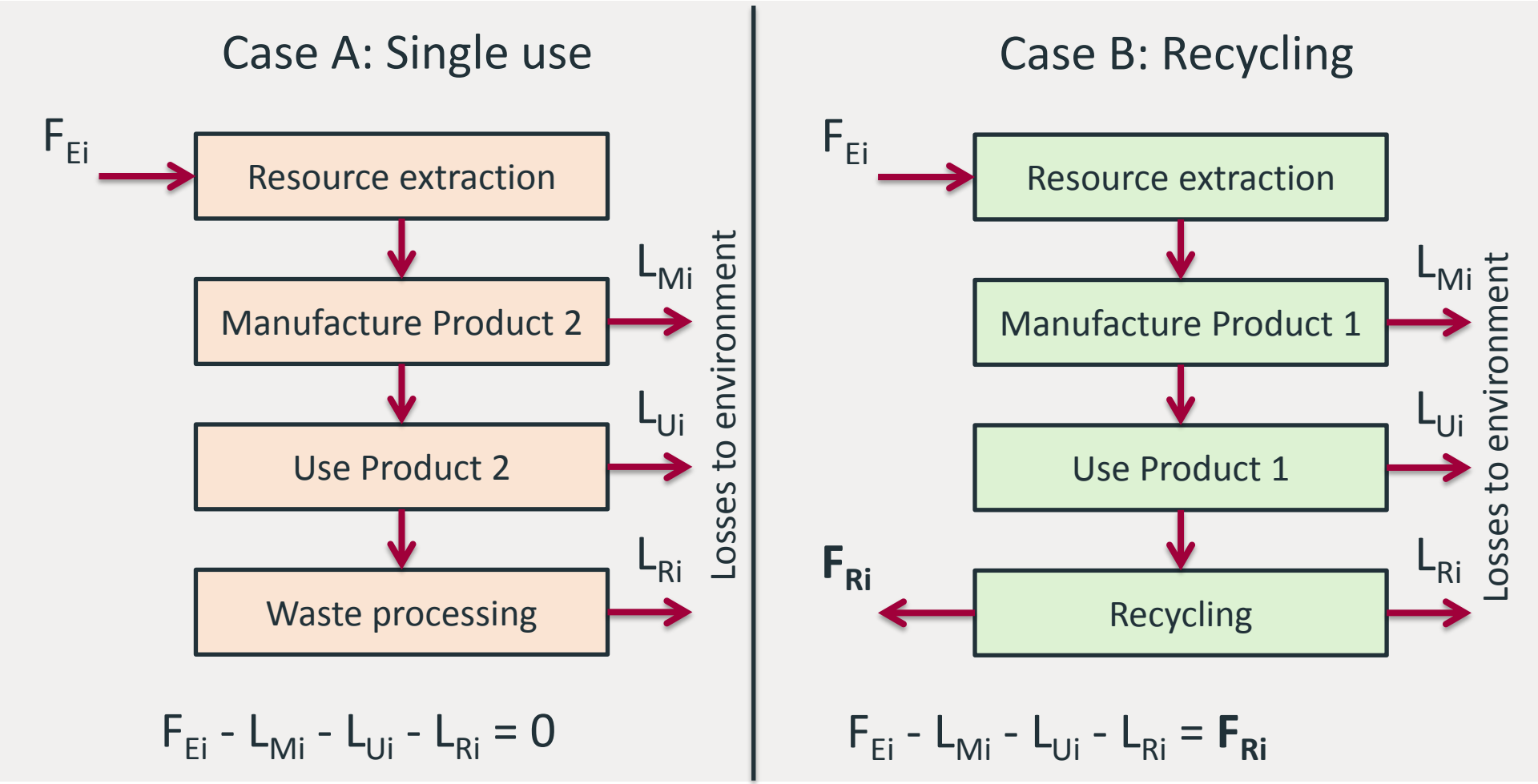
What others do: the «water» case

- Water resources are
  - withdrawn/extracted (from ground and surface water)
  - purified
  - used
  - released back to water bodies, or
  - lost (evaporated, embedded in product or released to other water body)
- Water footprinting community distinguishes between
  - assessing **water withdrawn**
  - assessing **water consumed = water lost**

The «mineral primary resources» case

- Mineral primary resources are
  - extracted
  - purified/refined/concentrated
  - used
  - recycled, dispersed or disposed off (landfilled)
- Two approaches in assessing mineral primary resource consumption
  - assess amount of **resources extracted**
  - assess amount of **resources used dissipatively**

Resource use: two cases
Post consumer resource availability

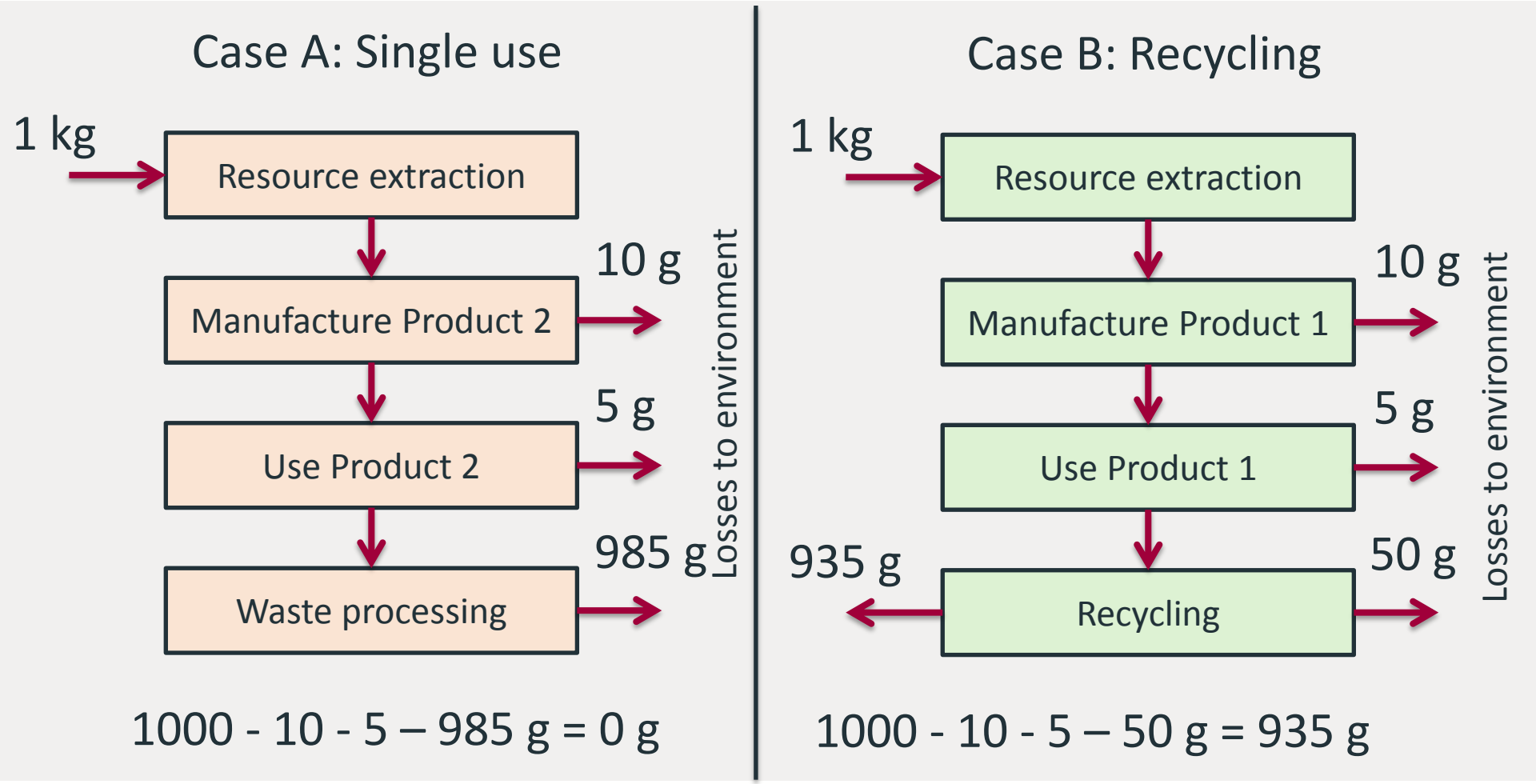


Example Aluminium

- Case A: Single use (Consumptive use)

- Case B: Recycling (Borrowing use)

Resource use: two cases
Quantified example



Assessing the **resources extracted**

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	Case A: Single use	Case B: Recycling
Amount of resource extracted	1 kg	1 kg
Resource impact factor	300 UBP/kg	300 UBP/kg
Resource related impact	**300 UBP**	**300 UBP**

Assessing the **resources consumed** (dissipatively used resources)

	Case A: Single use	Case B: Recycling
Amount of resource extracted	1 kg	1 kg
Amount of resource lost	1 kg	65 g
Resource impact factor	300 UBP/kg	300 UBP/kg
Resource related impact	**300 UBP**	**19.5 UBP**

Overview of results

	Case A: Single use	Case B: Recycling
Resources **extracted**	300 UBP	300 UBP
Resources **consumed**	300 UBP	19.5 UBP

Ecological scarcity ’13

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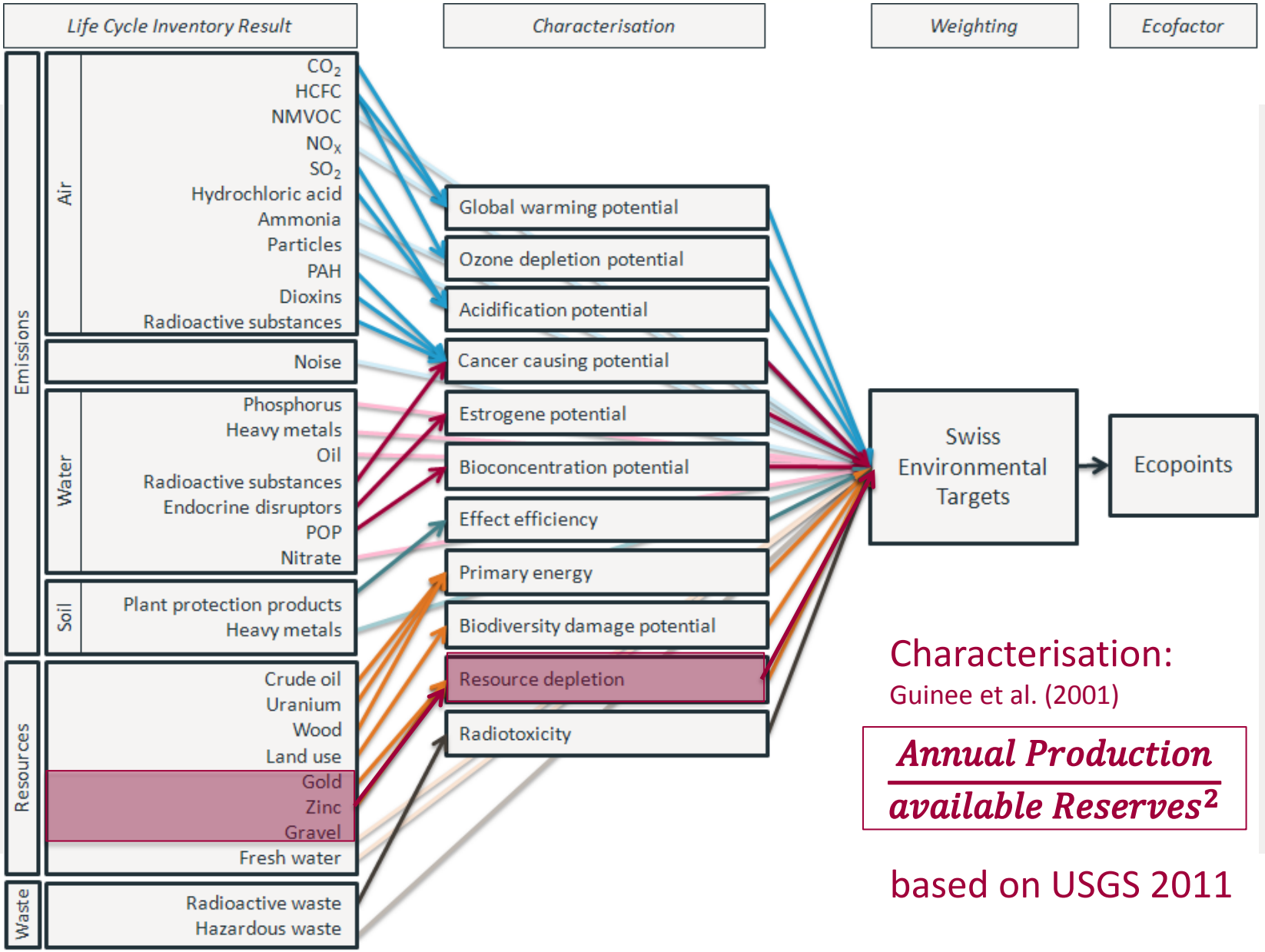

Characterisation:
Guinee et al. (2001)

$$\frac{\textit{Annual Production}}{\textit{available Reserves}^2}$$

based on USGS 2011

Recommended application of resource eco-factors

- Based on the political target the eco-factors should not address the extraction of a resource but the **dissipative use** only
- Dissipative use = materials are degraded, dispersed and lost in the course of usage and no longer (economically) available for future usage
- Remaining portion is only «on loan»

→ Eco-factors are applied to the difference between resource extraction and recycled resources

Open question

- When consider a resource being lost, being used dissipatively?
  Examples:
  - copper used as pesticide
  - steel can burnt and its slag landfilled
  - steel can landfilled directly
- Potential criteria
  - recovery costs (economical today)
  - resource concentration
    (similar to concentration in currently exploited mines)

Thank you very much for your attention!

contact:

frischknecht@treeze.ch

www.treeze.ch

ecological scarcity method 2013

www.treeze.ch/projects/methodology-development/life-cycle-impact-assessment/ecological-scarcity-method-2013/

Calculation of environmental impact of resource use

$$EIR = R_{ex} \times ef_R - R_{rec} \times ef_R = R_{diss} \times ef_R + R_{landf} \times ef_R$$

EIR: environmental impact of the resource

R_{ex}: amount of resource extracted

R_{rec}: amount of resource recycled

R_{diss}: amount of resource dissipated to nature (emitted to air, water, soil)

R_{landf}: amount of resource landfilled

ef_R: eco-factor of the resource ("resource depletion" only, not including environmental impacts caused during mining etc).