

Willkommen  
Welcome  
Bienvenue



Materials Science and Technology

## Resource pressure

A circular design method preceding LCA

Harald Desing

Technology & Society Laboratory (TSL), Empa, Lerchenfeldstrasse 5,  
9014 St. Gallen, Switzerland

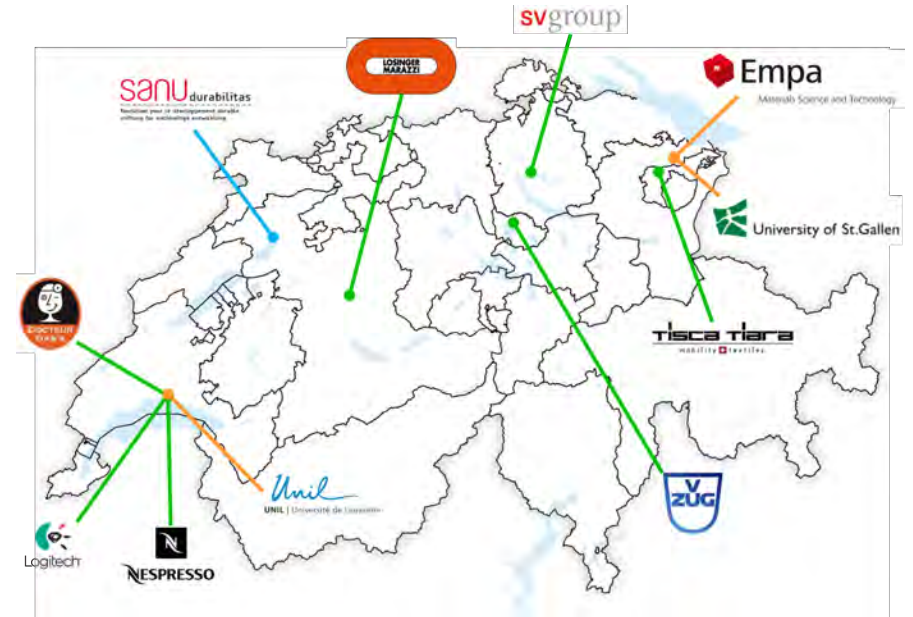
Project: Laboratory for Applied Circular Economy (LACE)



# Context: Laboratory for Applied Circular Economy

Exploring possible pathways for a **sustainable CE** application in Switzerland:

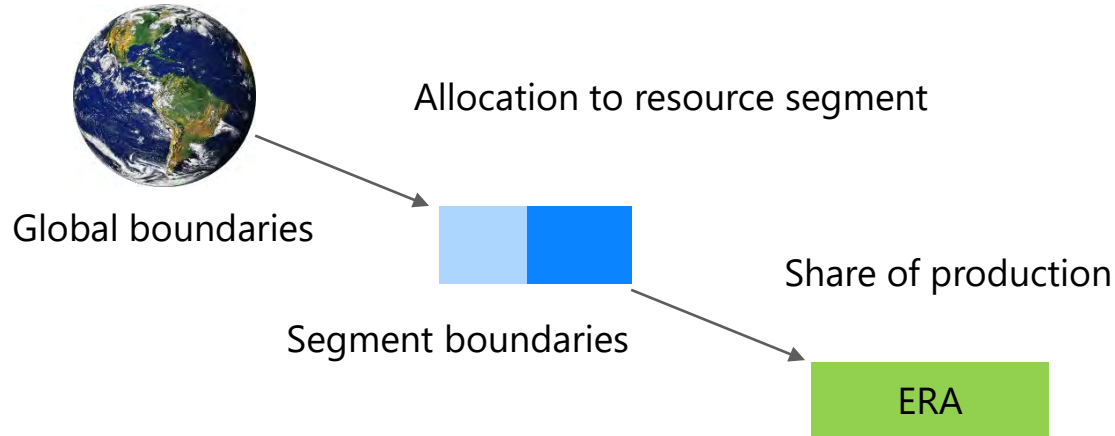
- Inter-disciplinary
  - Environmental & technical perspective
  - Legal perspective
  - Business perspective
- Trans-disciplinary
  - 7 industry partner
  - Knowledge transfer partner



How to ensure **effective utilization** of limited resources through the design of circular products and services?



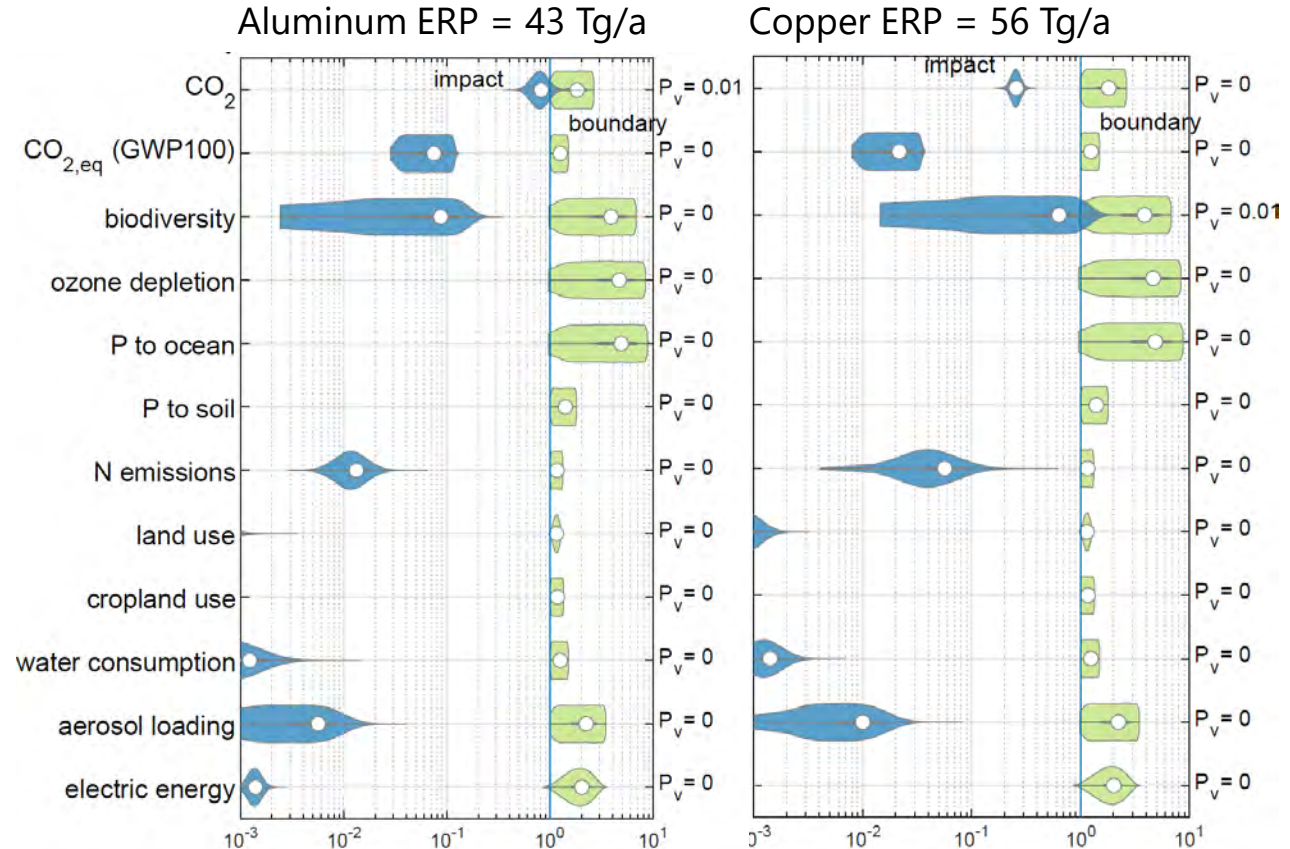
# Ecological resource availability



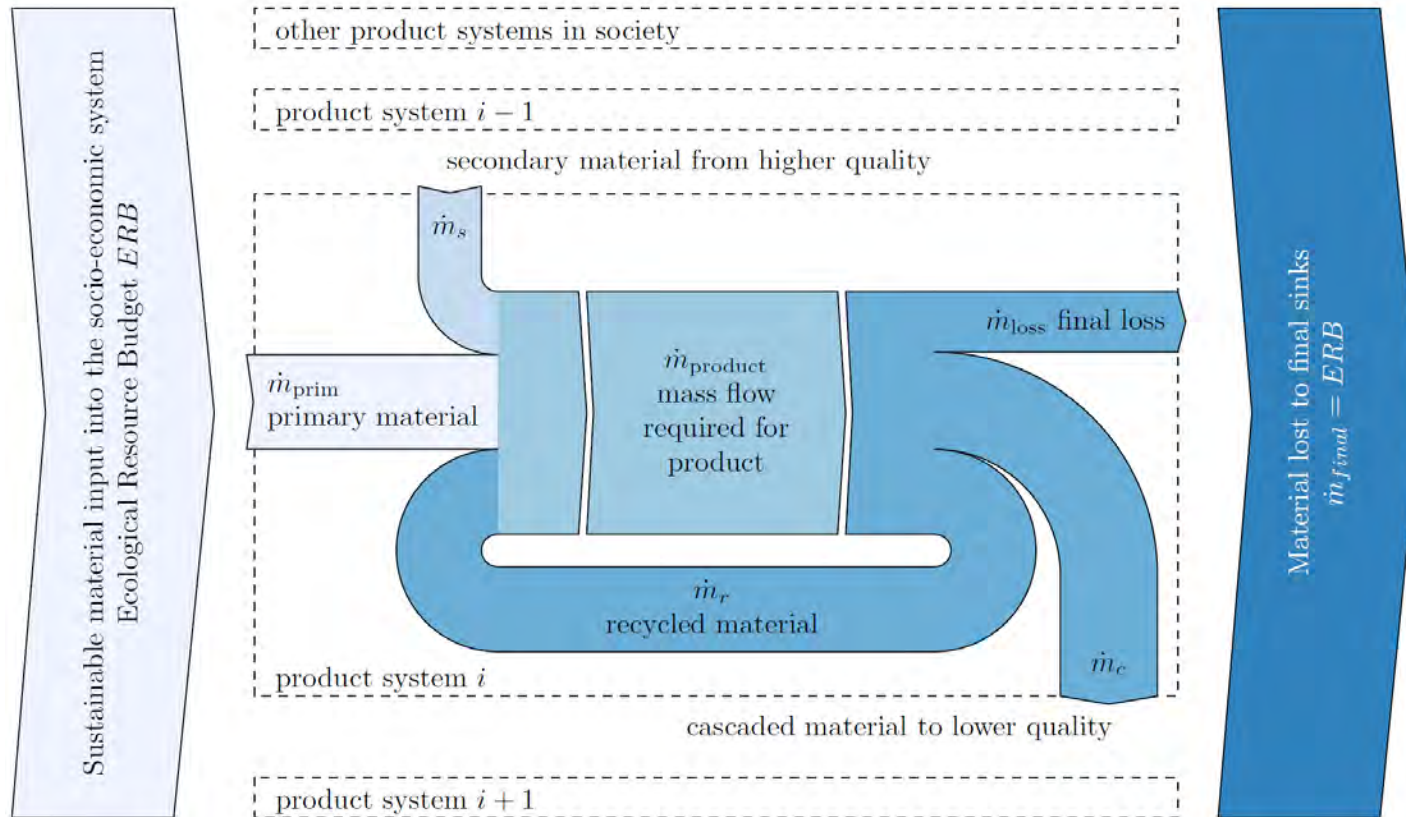


# Ecological resource potentials

- Do not require allocation
- Maximum theoretical potential to produce one material within Earth system boundaries, when no other anthropogenic activity would take place
- Fits the design objective: "Minimize pressure on Earth system boundaries"
- Not to be used as an absolute benchmark

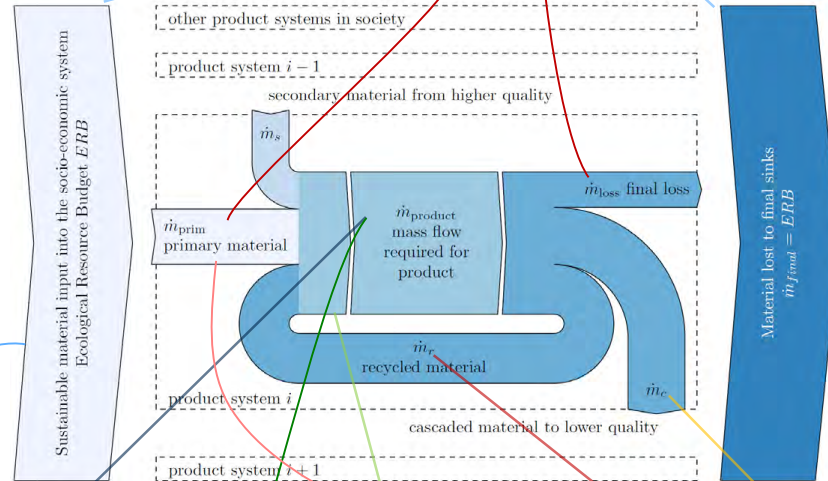


# Resource flow through a product system



# Resource pressure

$$\tau = \frac{1}{2} \frac{\dot{m}_{prim}}{ERB} + \frac{1}{2} \frac{\dot{m}_{loss}}{ERB}$$



$$\tau = \frac{1}{2} \frac{\dot{m}_{product}}{ERB} \frac{1}{t_L} (1 + \gamma_m)(1 + \alpha - \eta_r - \eta_c)$$

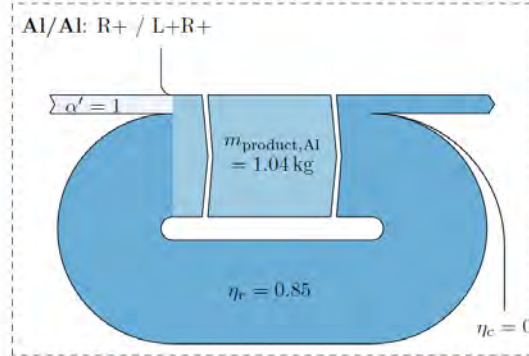
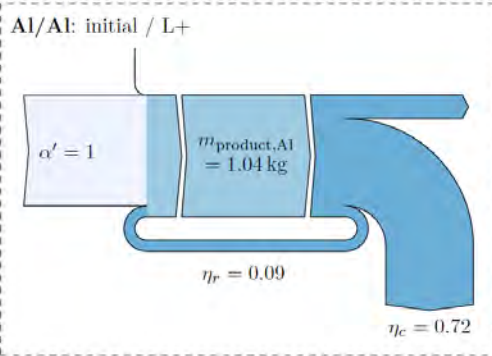


# Case study: heat exchanger for tumble dryer

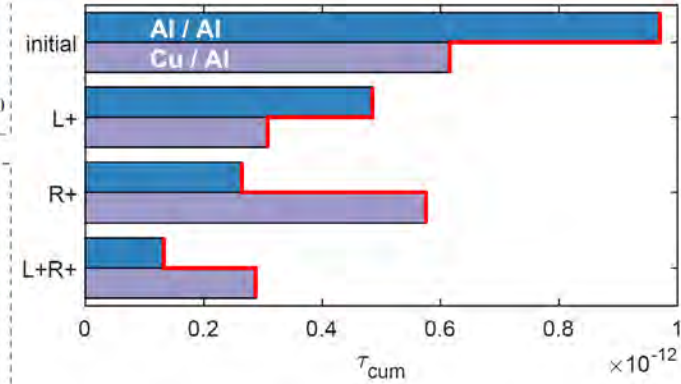
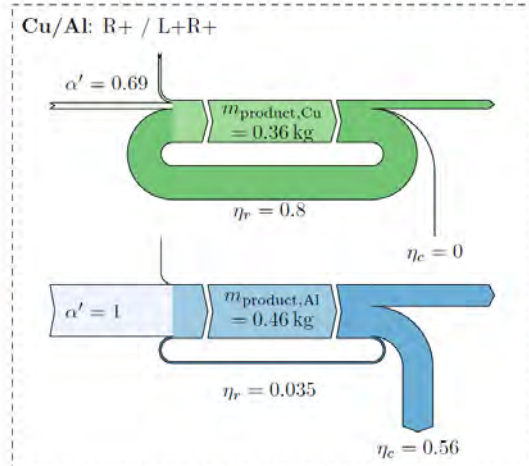
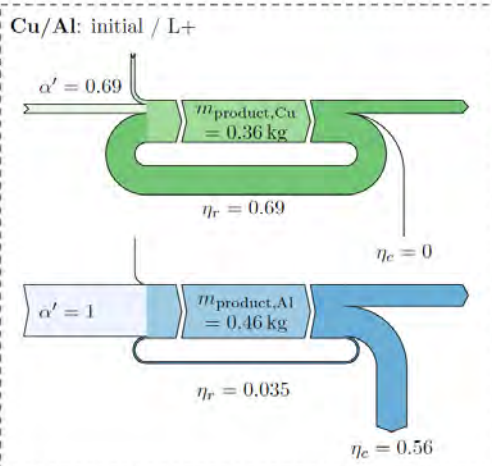
Al/Al

WEEE recycling system (CH)

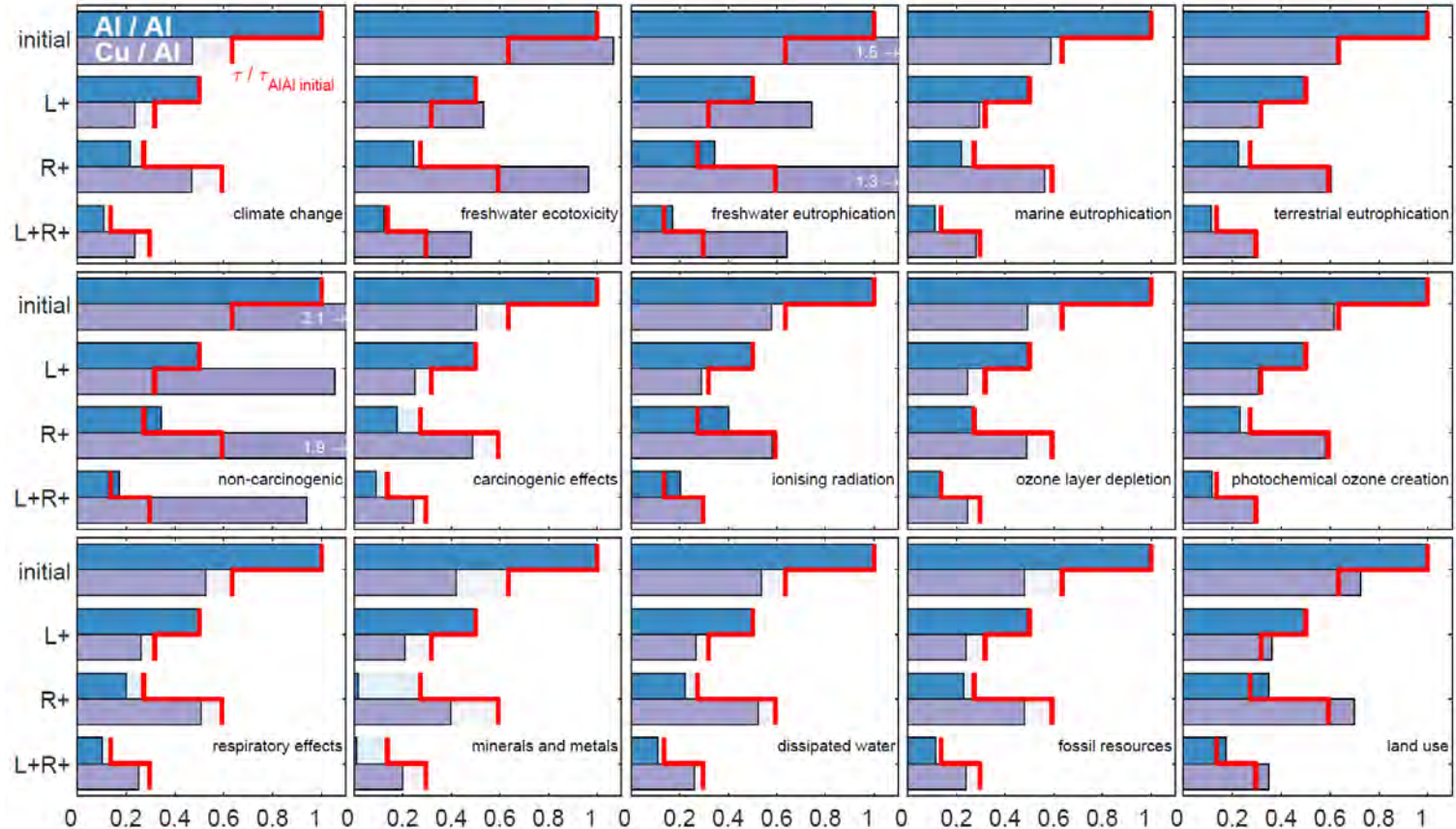
component disassembly



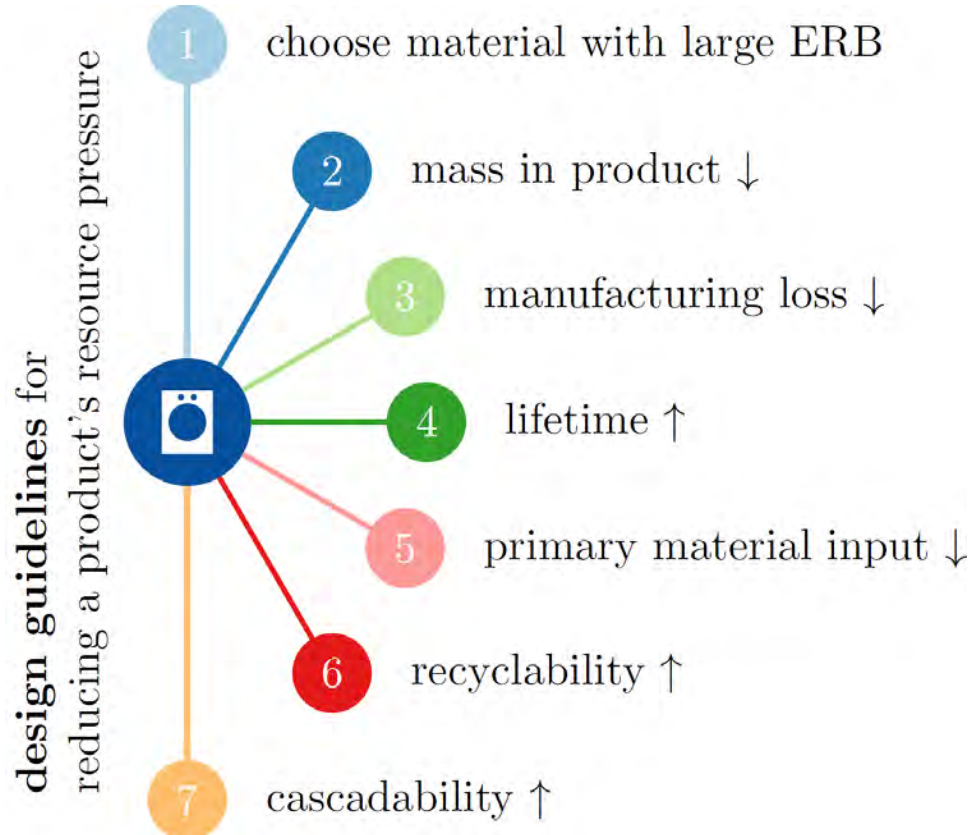
Cu/Al



# Comparison to simplified LCA



# Design guidelines



- Targeted to be used by product designers and engineers
    - Guidelines + single score indicator
    - Preceding more detailed LCA
    - Can be used for analysis of societal resource use (e.g. country, sector, company)
  - Can be applied to all sectors in principle
  - Evaluating the environmental benefits of circular design strategies
    - Different design objectives possible (ERA/ERP, removal of toxic substances)
    - Social aspects are not (yet) considered
    - Economic aspects are not considered (core competence of every enterprise)
- The resource pressure method can show what is possible with technical improvements, but it can also show what is necessary in reduction of demand and change in user behavior to reach the goal of a sustainable society.



# Questions?



# Empa

Materials Science and Technology



Harald Desing  
Empa - Technology and Society Lab  
Lerchenfeldstraße 5  
9014 St.Gallen  
[Harald.desing@empa.ch](mailto:Harald.desing@empa.ch)  
[www.empa.ch](http://www.empa.ch)

## Thank you for your attention!