

Willkommen
Welcome
Bienvenue



Challenge of Impact assessment for by-product and co-product metal

Xiaoyue Du, Roland Hirschler, Patrick Wäger

EMPA, Switzerland

April 11, 2014

LCA DF55

Modul 1: System analysis

Quantification and screening of critical metals in WEEE

Modul 2: Case studies

Recycling

Collection and logistics

Economic and ecological aspects

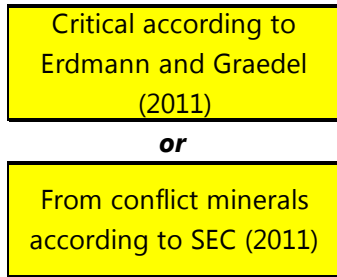
Modul 3: Recycling system of critical metals

Recycling system

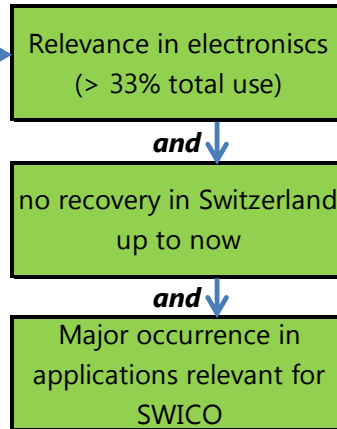
Preparation and improvement

E-RECMET project

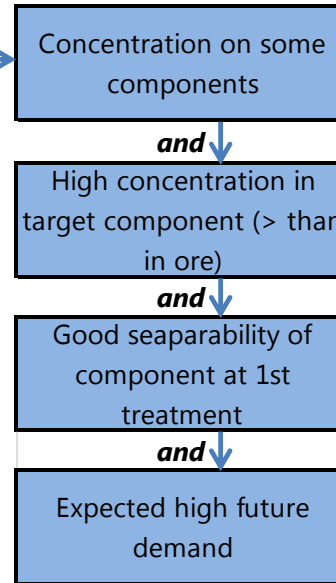
CRITICALITY



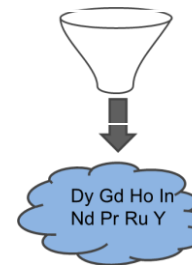
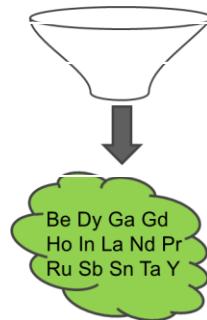
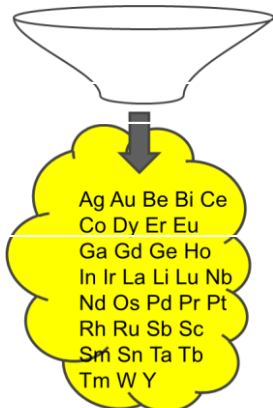
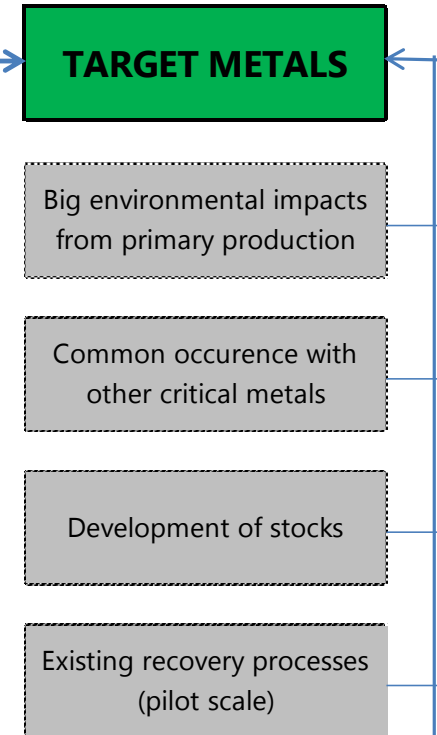
RELEVANCE



POTENTIAL



PRIORIZATION



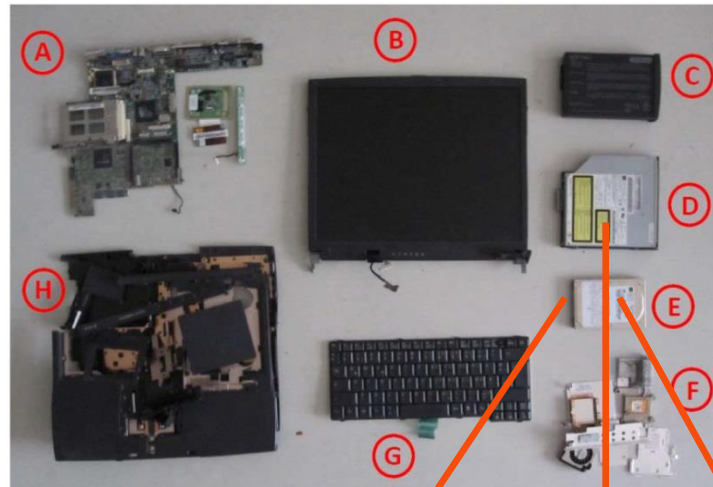
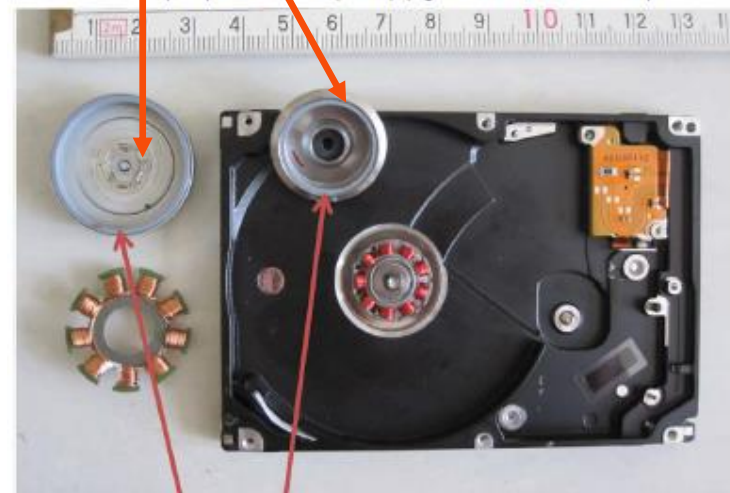
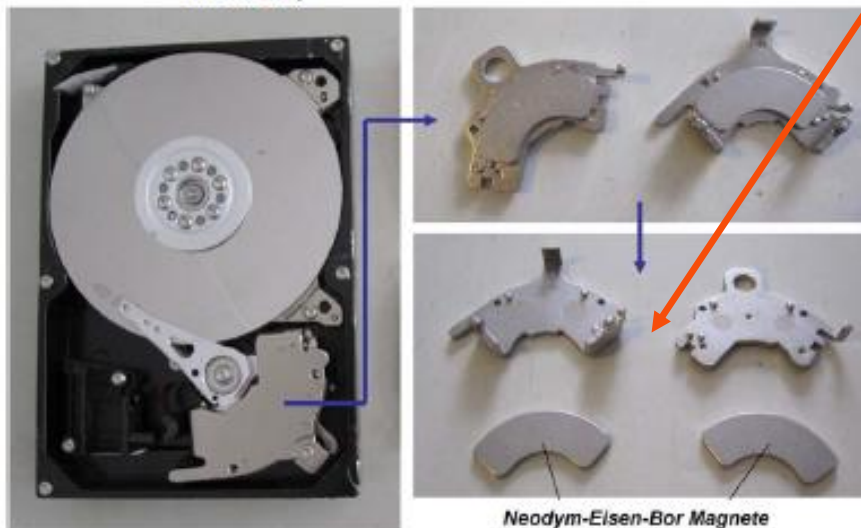


Abbildung 11 Seltene Erden Magnete des Schwingspulenbetätigers (eigene Aufnahmen Oko-Institut)

Abbildung 12 Geöffnete Spindelmotoren mit Ringmagneten von optischem Laufwerk (links) und Festplatte (rechts), (eigene Aufnahme Oko-Institut)



Ringmagnete von Spindelmotoren

E-RECMET project

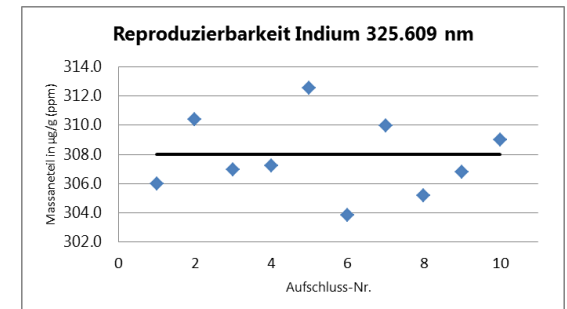
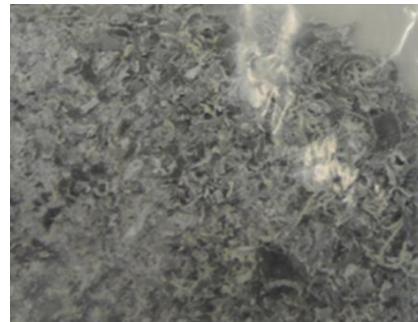
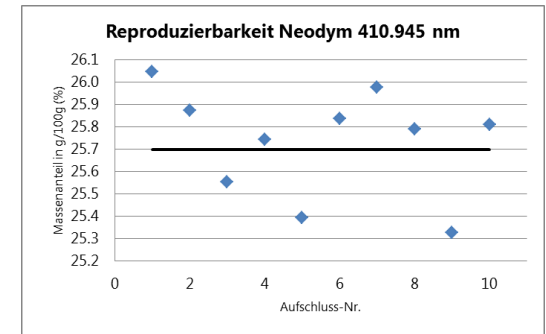
Sample



Sample preparation



Chemical analysis



Neodymium and Indium Primary and Secondary Production

- Improve Life Cycle Inventory
- Develop Life Cycle Assessment
- Compare the impact

■ **Nd Primary Production**

- Ore deposit, Rare earth concentrate, Rare earth oxide, Nd oxide (Nd metal)
- Bastnasite vs. Monazite

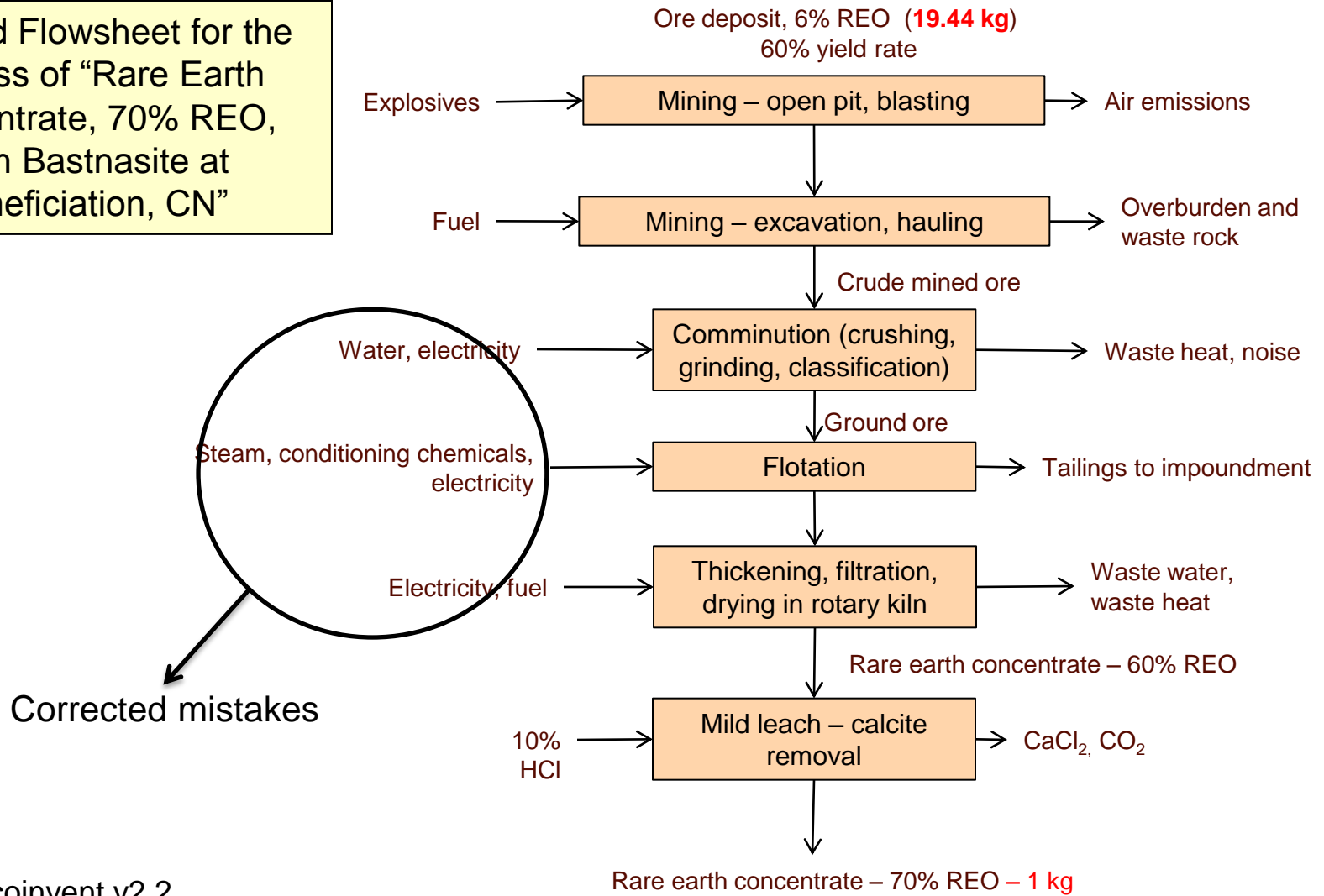
■ **Nd Secondary Production**

- Mainly focus on magnets
- Manual dismantling vs. Mechanic shredding
- Process 1: Nd Magnet to Nd magnet
- Process 2: Magnet to Nd oxide/Nd

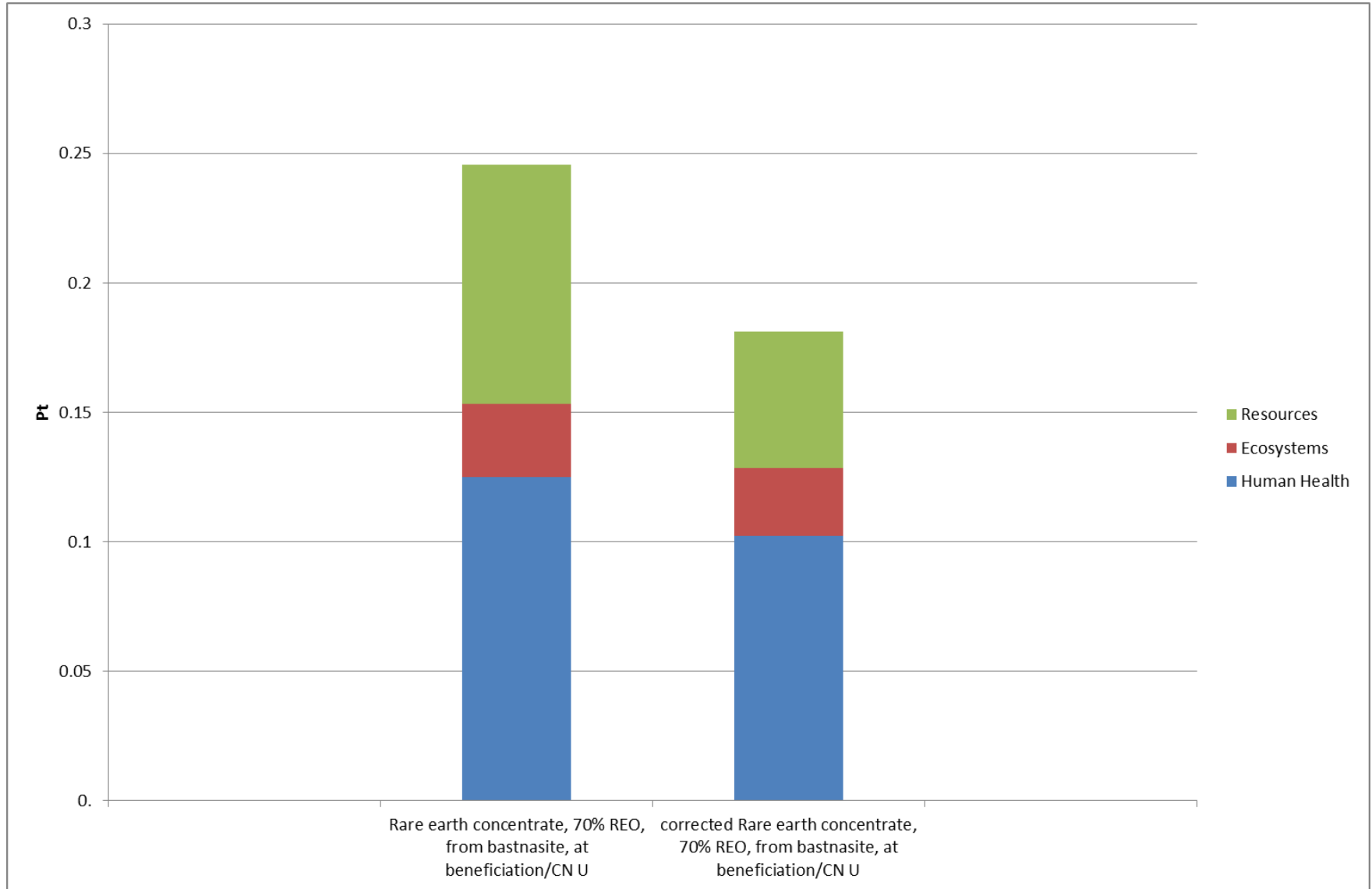
Neodymium primary production from bastinasite

Rare earth concentrate from ore deposit

Detailed Flowsheet for the process of “Rare Earth Concentrate, 70% REO, from Bastnasite at Beneficiation, CN”



Comparing 1 kg Rare Earth Concentrate

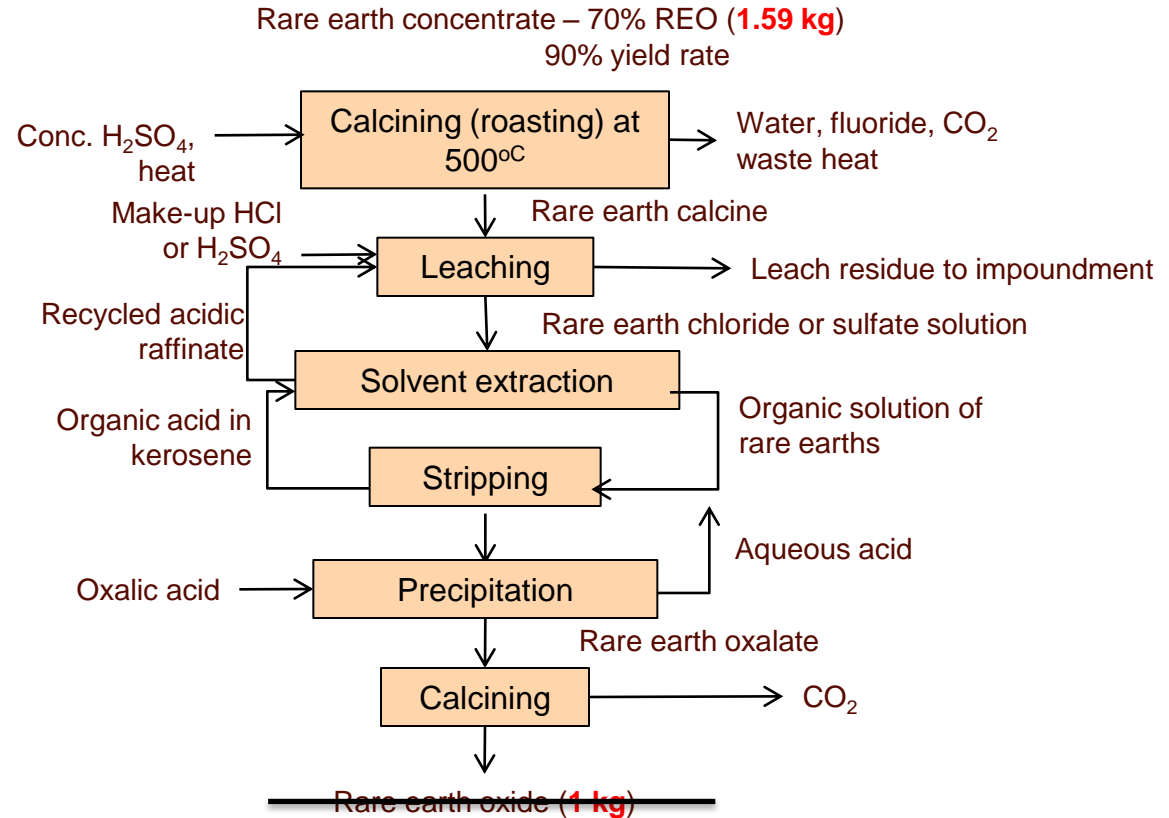


Method: ReCiPe Endpoint (H) V1.09 / World ReCiPe H/H / Single score

Neodymium primary production from bastnasite

Rare earth oxide from concentrate

Detailed Flowsheet for the
multi-output process of
“Rare Earth Oxide production
from Bastnasite”



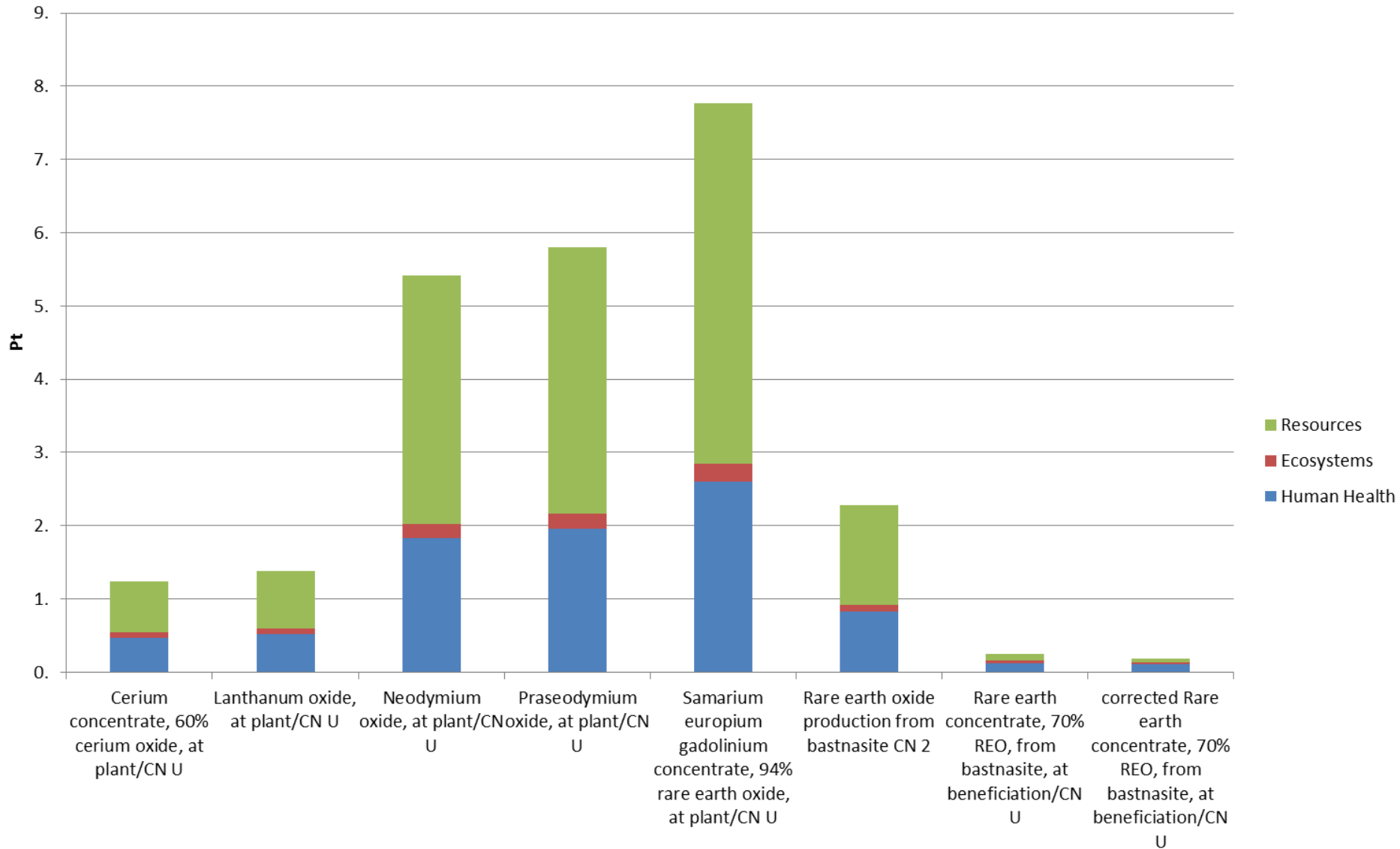
Lanthanum oxide, at plant/kg/CN (**1 kg**)
cerium concentrate, 60% cerium oxide, at plant/kg/CN (**1 kg**)

Neodymium oxide (**1 kg**)

Praseodymium oxide, at plant/kg/CN (**1 kg**)

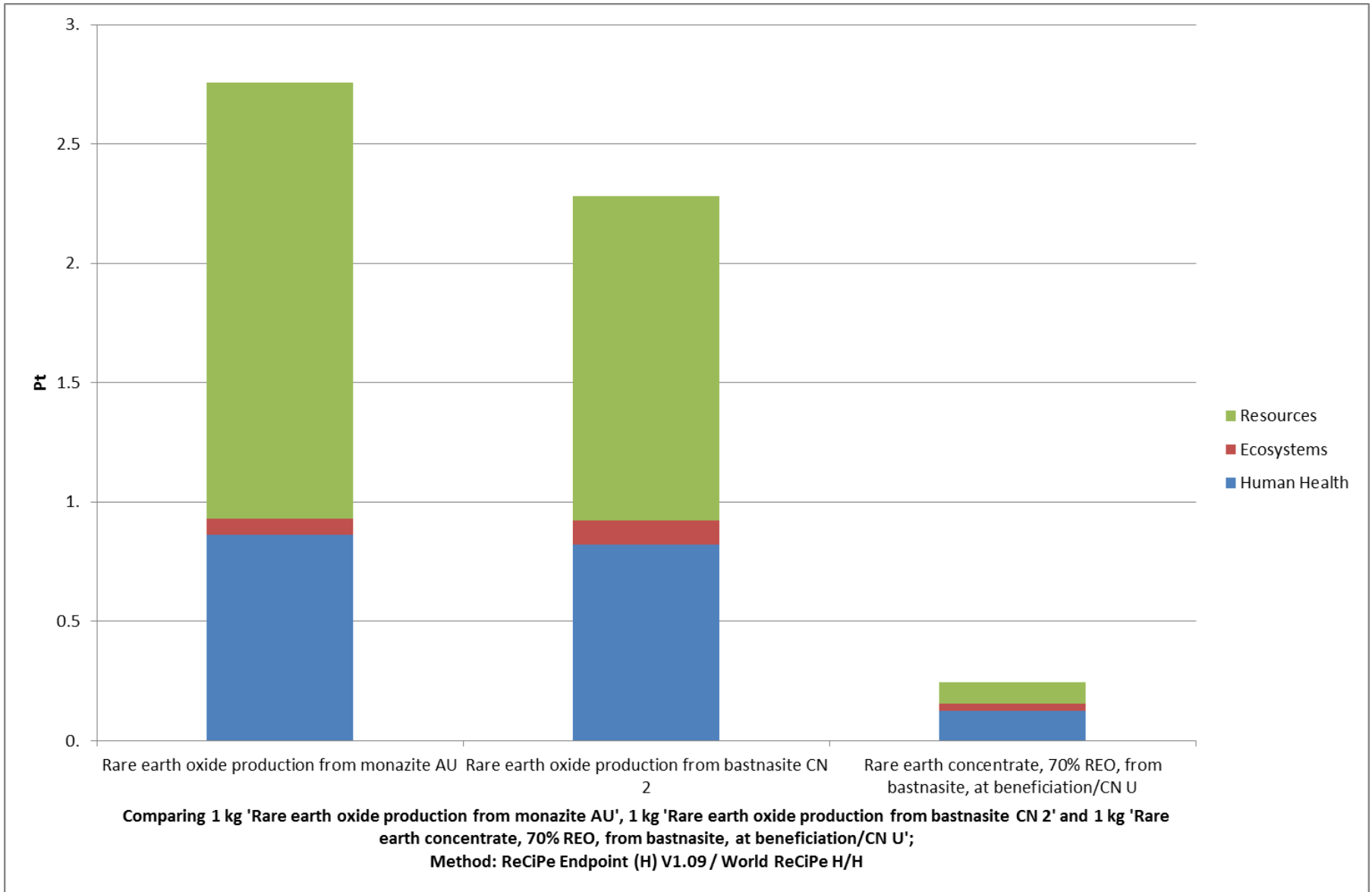
Samarium europium gadolinium concentrate, 94% rare earth oxide, at plant/kg/CN (**1 kg**)

Comparing 1kg Rare Earth Oxides

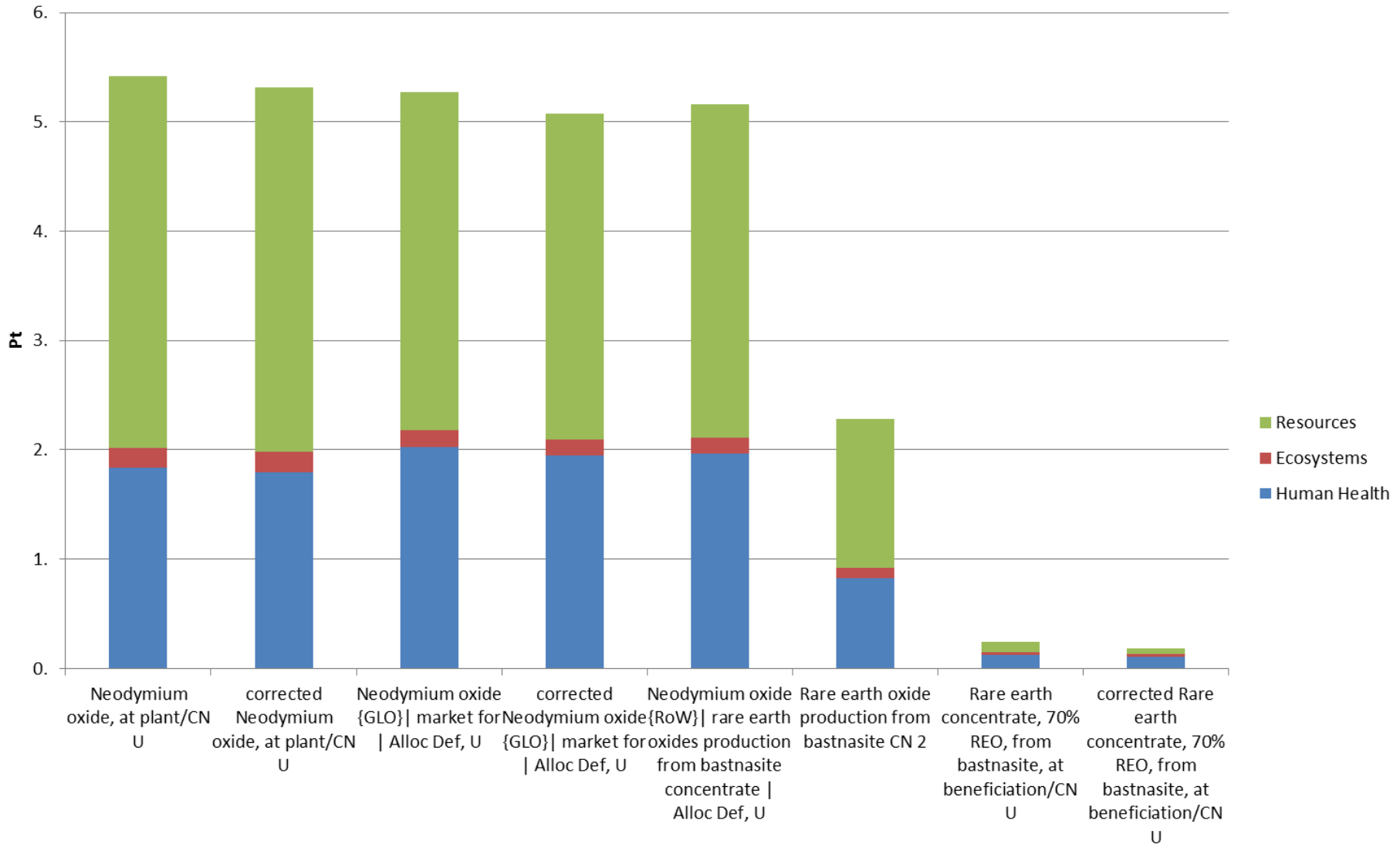


Comparing processes;
Method: ReCiPe Endpoint (H) V1.09 / World ReCiPe H/H / Single score

Comparing 1 kg rare earth oxide from monazite



Comparing 1kg Nd Oxide



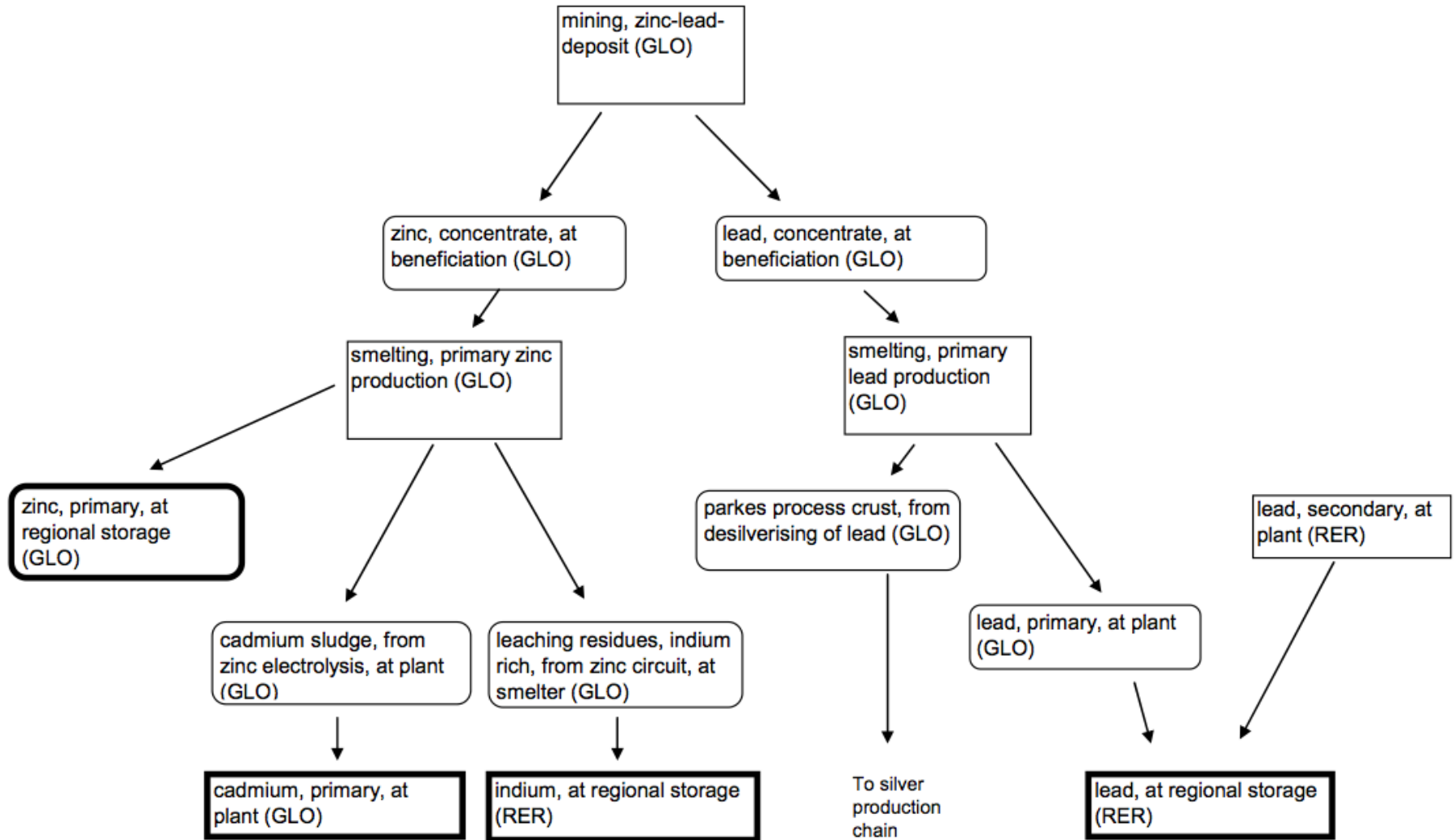
Comparing processes;
 Method: ReCiPe Endpoint (H) V1.09 / World ReCiPe H/H / Single score

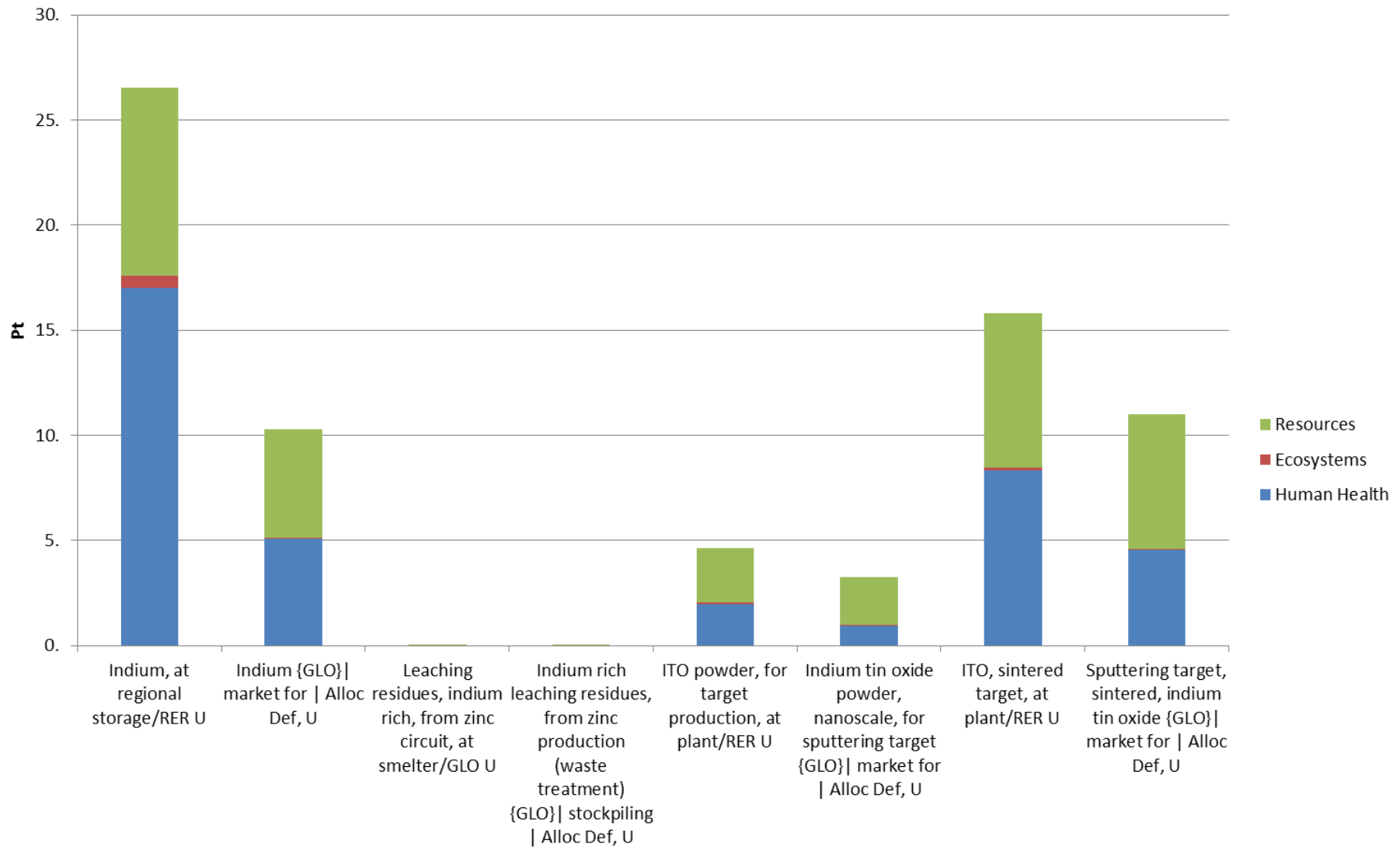
- **Nd Primary production**
- Nd oxide > REO > RE concentrate
- REO from monazite > REO from bastinasite
- RE concentrate from bastinasite > REO concentrate from monazite
- Impact is slightly lower in v3 than v2.2

- **In Primary Production**
- Zinc lead deposit, leaching residue, indium, indium stockpiling (ITO powder)

- **In Secondary Production**
- Mainly focus on LCD
- Compare different mechanical processing

Indium as by-product from Zinc-lead-deposit





Comparing processes;
 Method: ReCiPe Endpoint (H) V1.09 / World ReCiPe H/H / Single score

■ In Primary Production

■ In > > In leaching residue

■ Impact is much lower in v3 than v2.2

- Correction: the process “smelting, primary zinc production” GLO in v2.2 had 0.0033778kg of cadmium sludge, from zinc electrolysis and 0.33939kg of leaching residues, indium rich and in v3 it was corrected to 0.014kg and 1.235kg respectively. Similar changes were made also in other datasets in this supply chain.

- **Better allocation for by-product or co-product in primary production**
- **Comparing the primary and secondary production**
 - Nd as co-product in ore vs. Nd as main product in magnet
 - In as by-product in ore vs. In as co-product in LCD
- **Comparing different metals in secondary production**
- **Allocation in secondary production**
 - e.g. In in the screen vs. Cu in PCB in computer

Thank you!
Xiaoyue.du@empa.ch

