HELMHOLTZ
ZENTRUM DRESDEN
ROSSENDORF

TU BERGAKADEMIE · FREIBERG ·

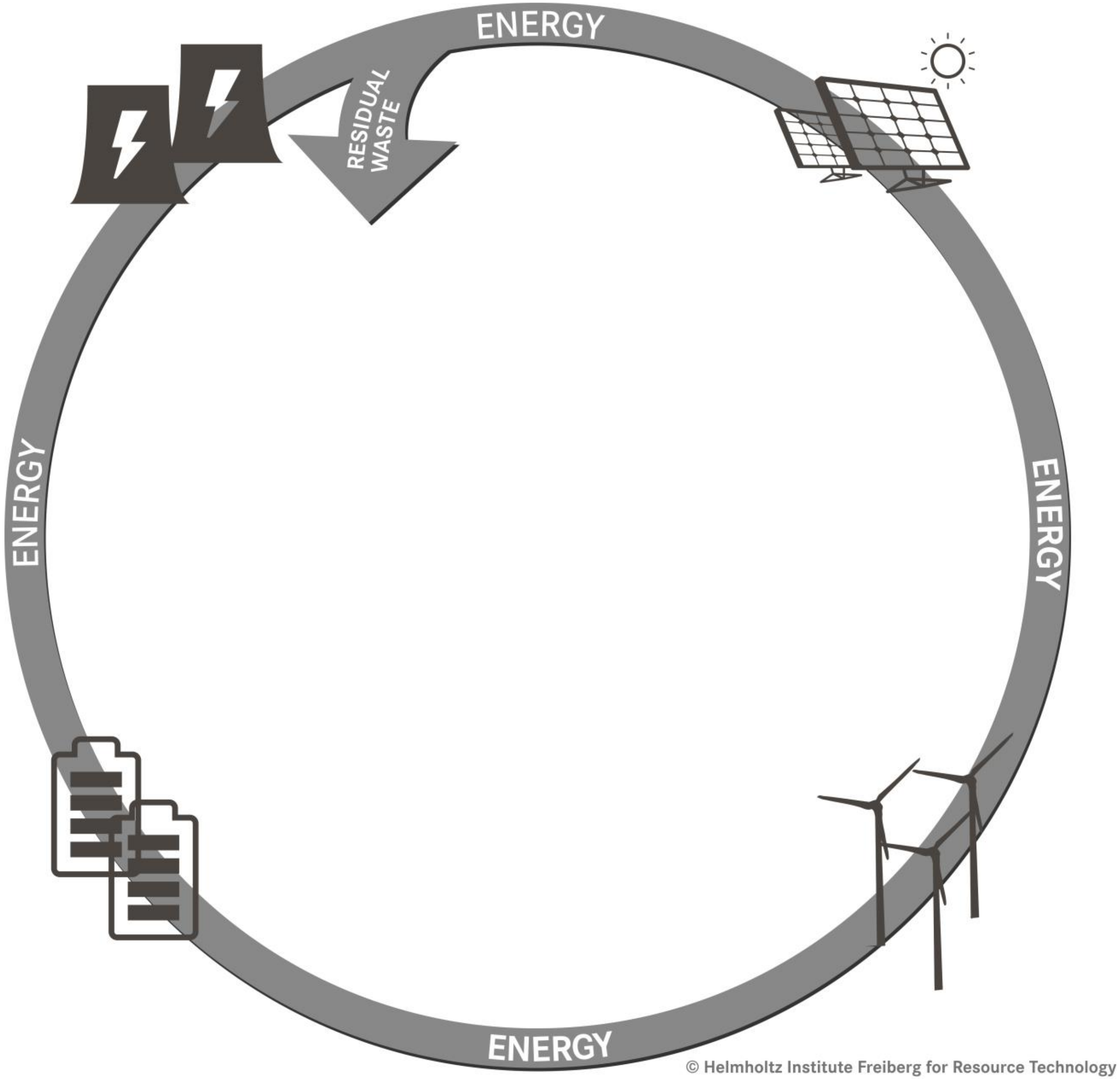
The (Geo)Metallurgy of the Circular Economy

Markus A. Reuter

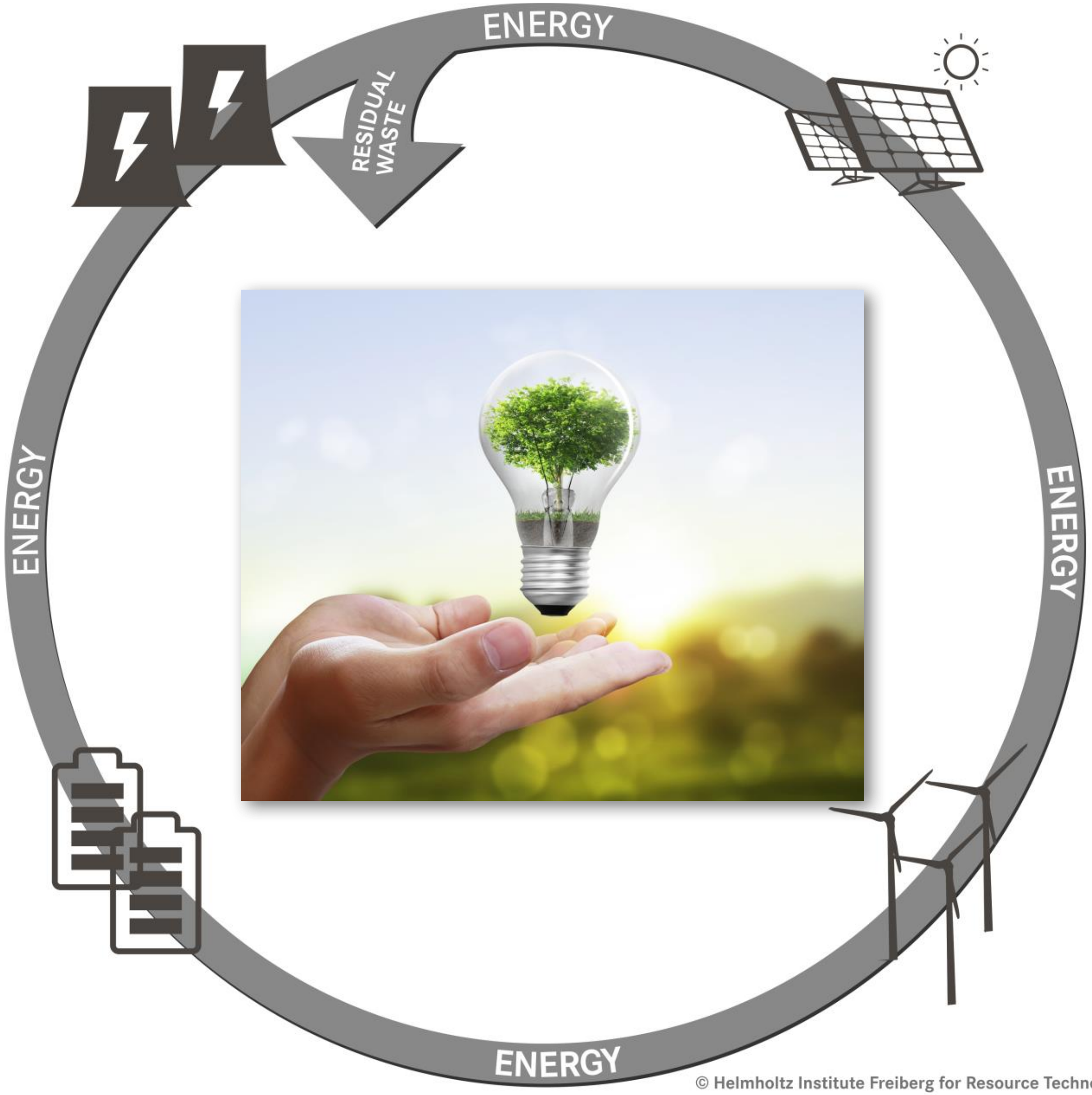
From: M.A. Reuter (2016): Digitalizing the Circular Economy-Circular Economy Engineering defined by the metallurgical Internet of Things- 2016 TMS EPD Distinguished Lecture Award, USA, Metallurgical Transactions B (http://link.springer.com/article/10.1007/s11663-016-0735-5).

Prof. Dr. Dr. h.c. Markus A. Reuter
Helmholtz Institute Freiberg for Resource Technology©

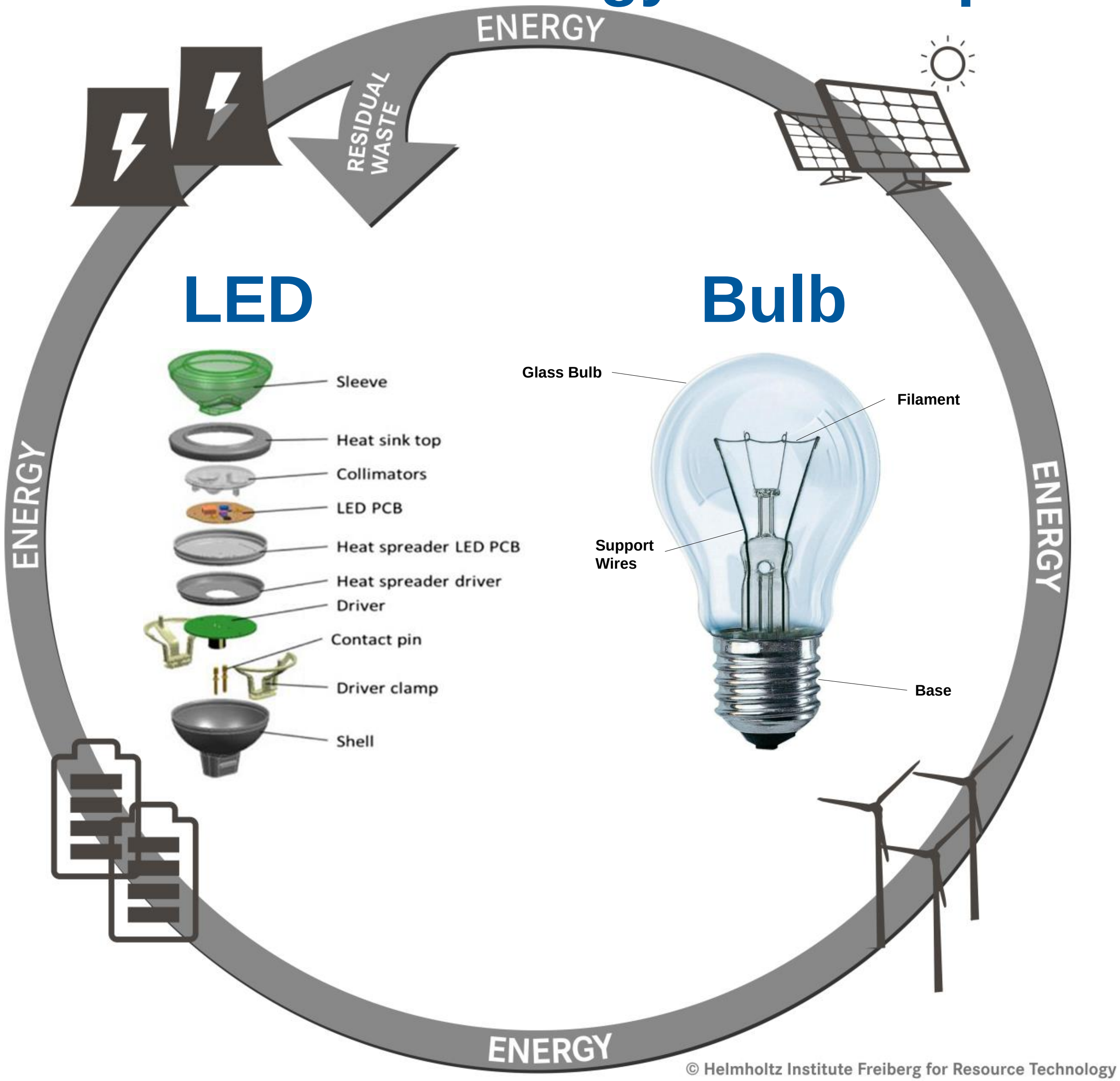
Energy system often considered separately…



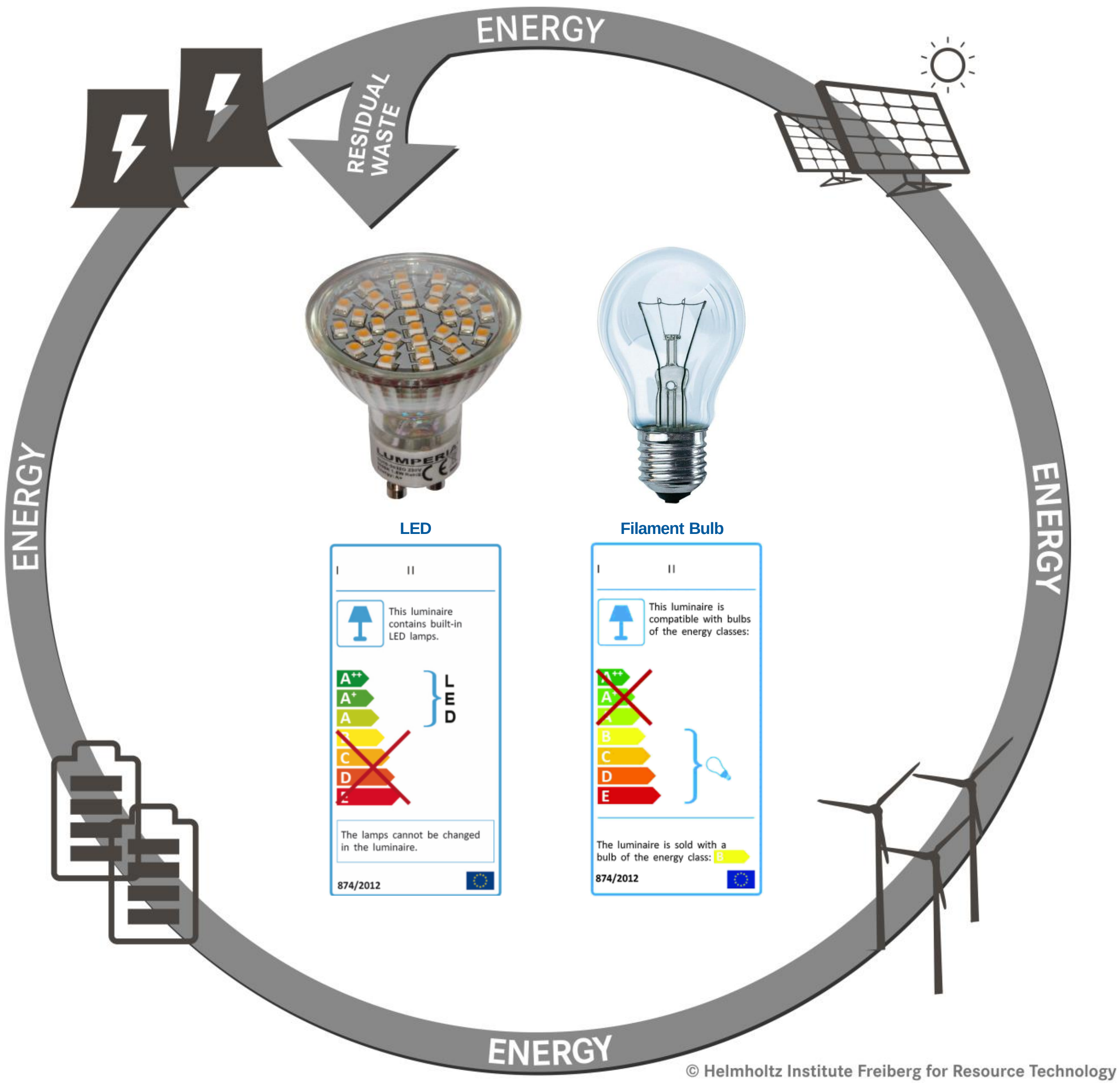
We talk about energy efficiency...



Forgotten is the complexity of renewable energy systems + embodied energy and footprint...



Which is more resource efficient?



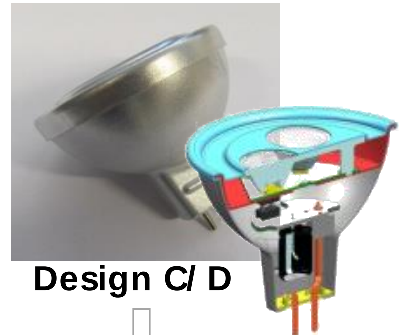
Prof. Dr. Dr. h.c. Markus A. Reuter
Helmholtz Institute Freiberg for Resource Technology©

How does complexity affect resource efficiency?

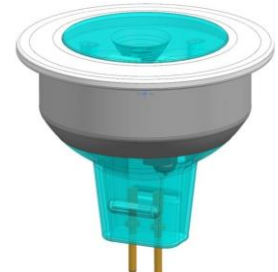
Different LED lamp (Re) Designs

Design A

Design B

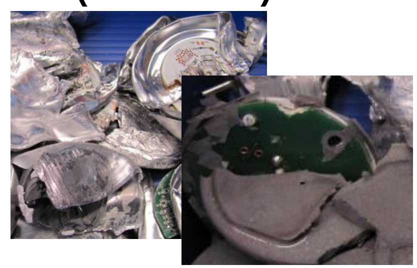


Design C/ D



Design E

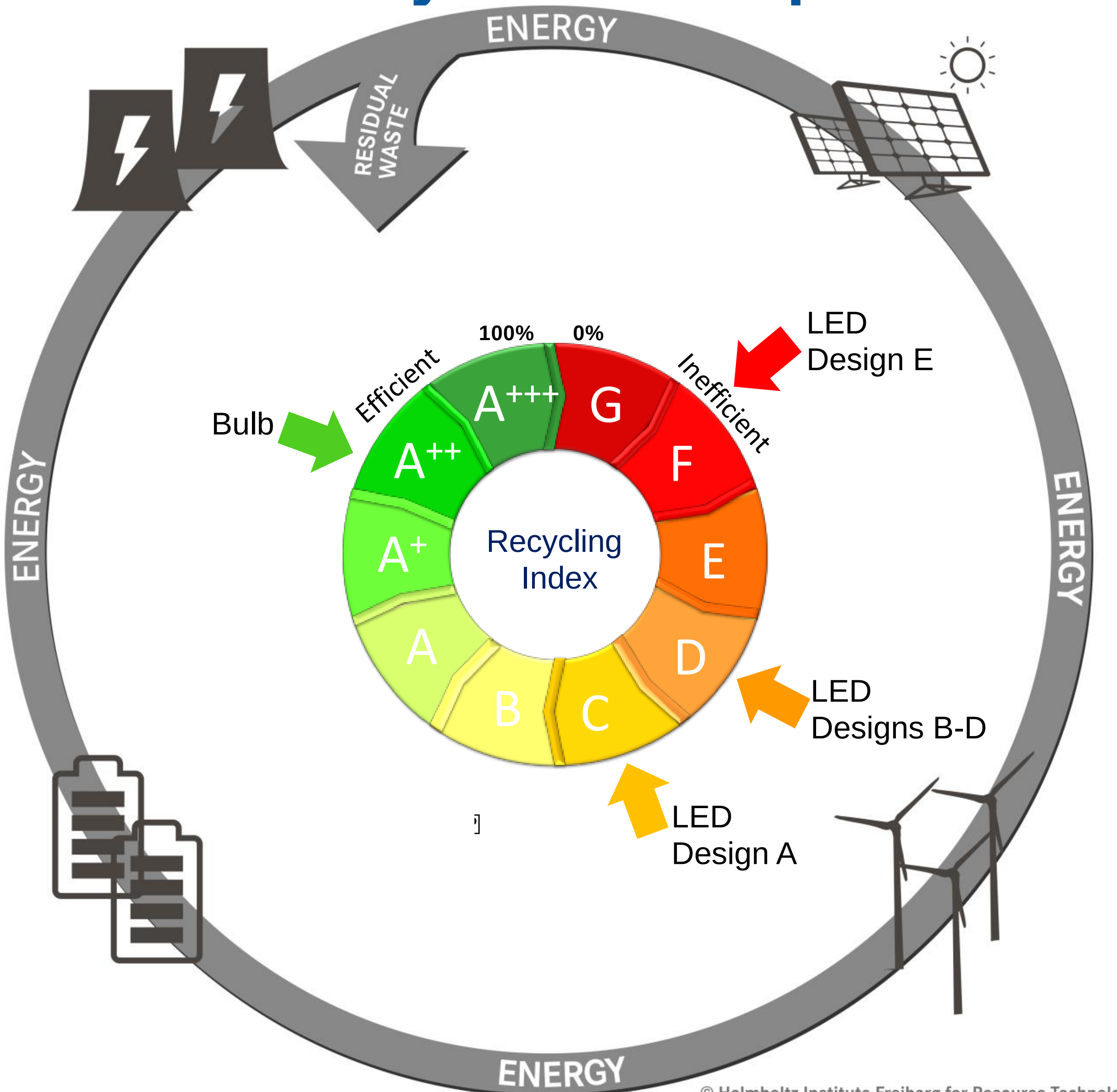
Particle/ fragment composition (liberation) after shredding



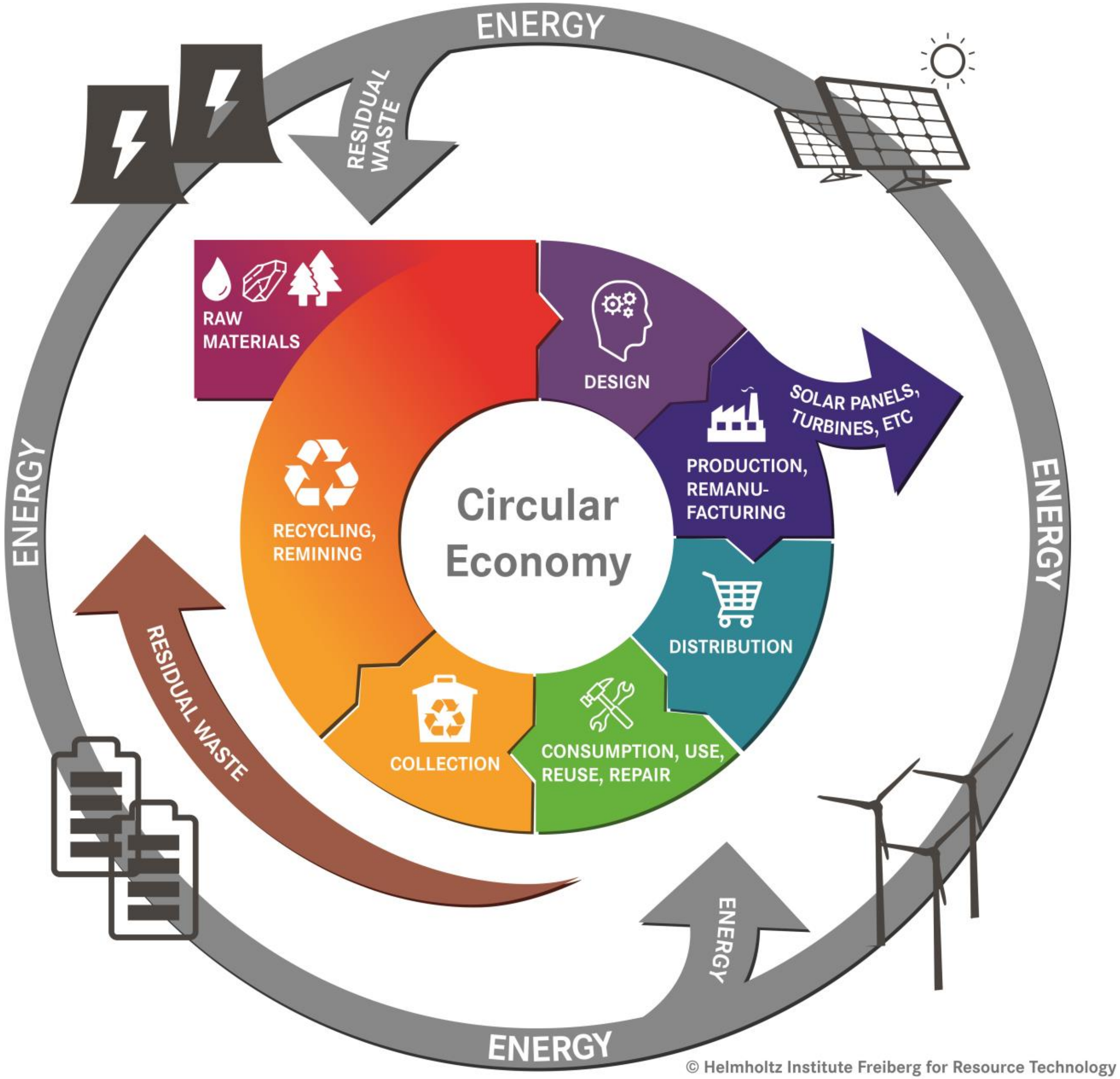
Different recyclates from LED lamp recycling : Ferrous, PCBA/ metal rich, plastics, aluminium

Prof. Dr. Dr. h.c. Markus A. Reuter
Helmholtz Institute Freiberg for Resource Technology©

...and ultimately also how much material can truly flow back into the system to improve RE?

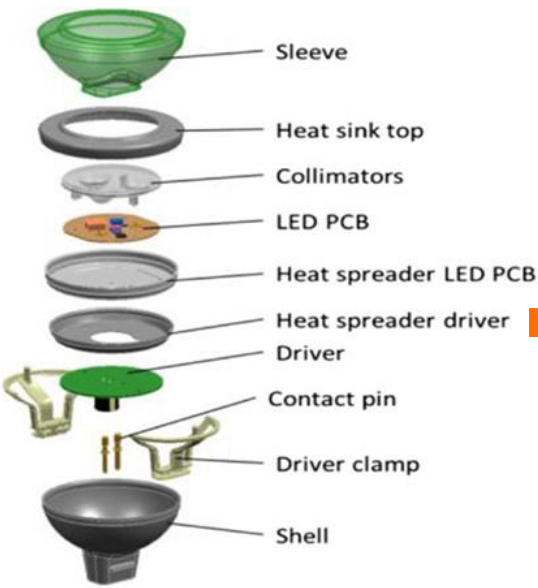


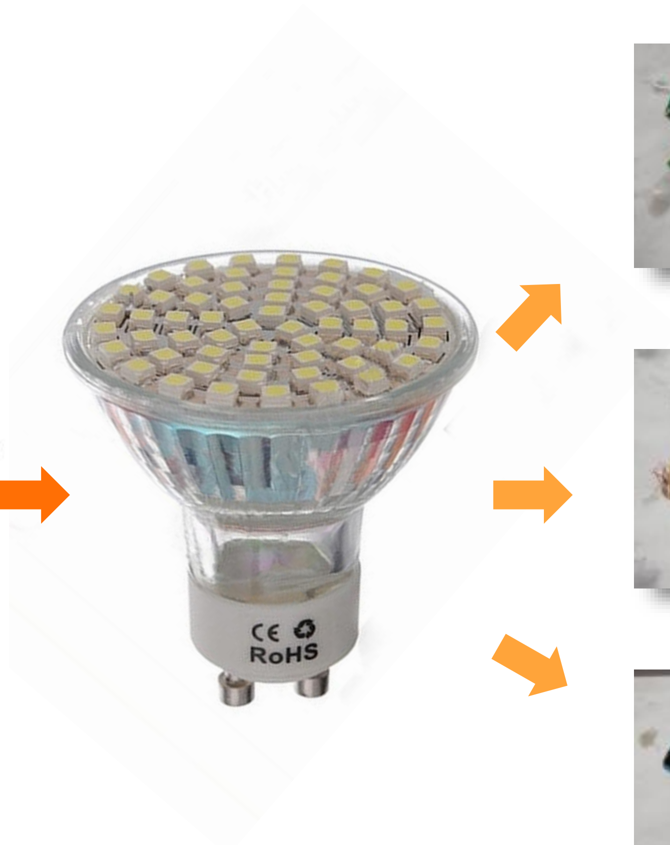
Linking resources, materials & energy systems!



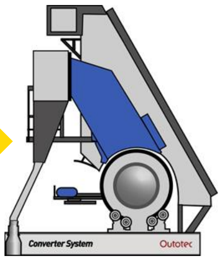
So how do we optimize the “urban mine”?

(Geo)Metallurgy a key to the system?

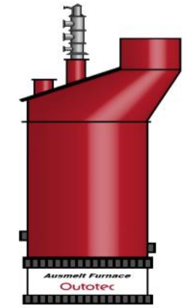




Au



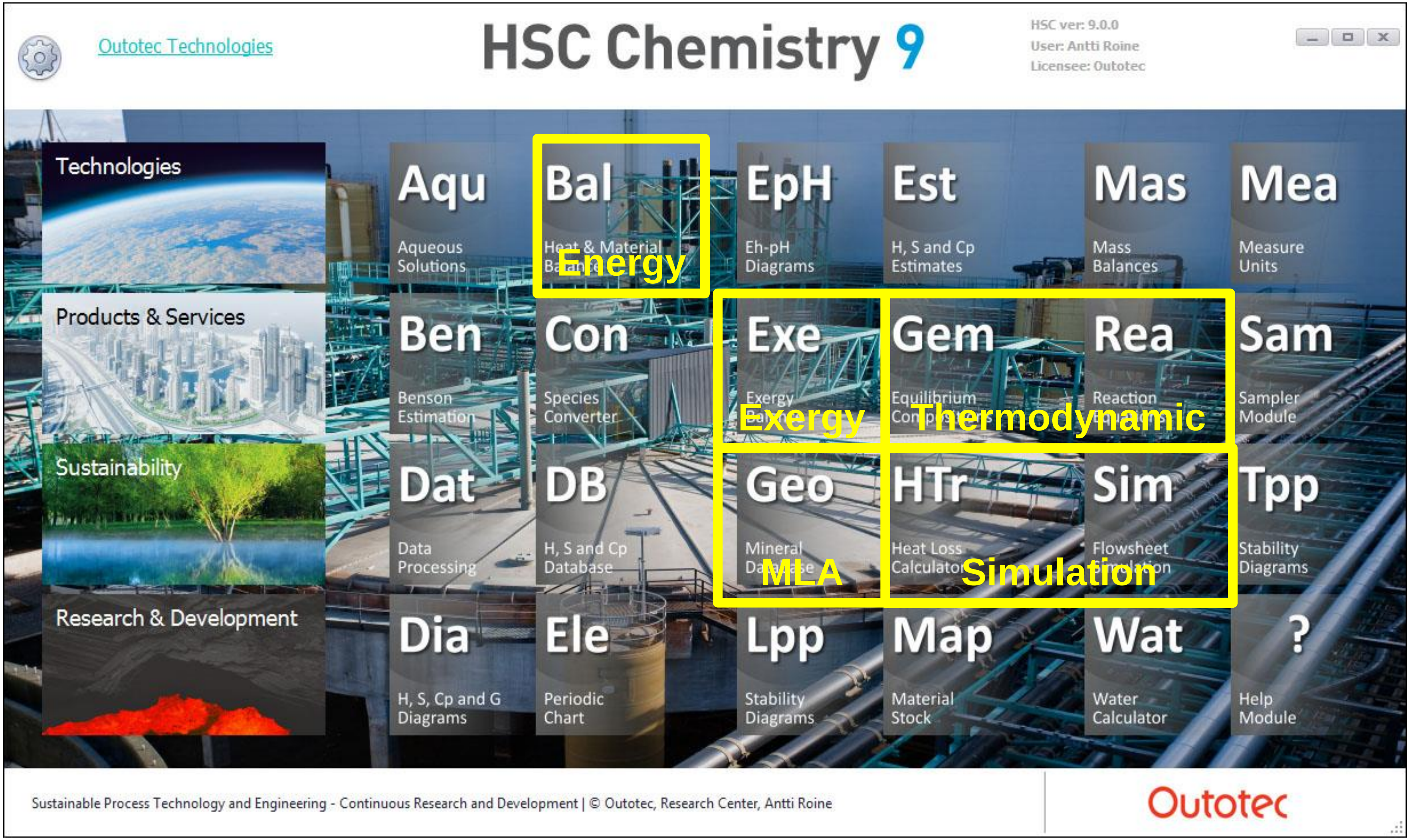
Cu



Ta

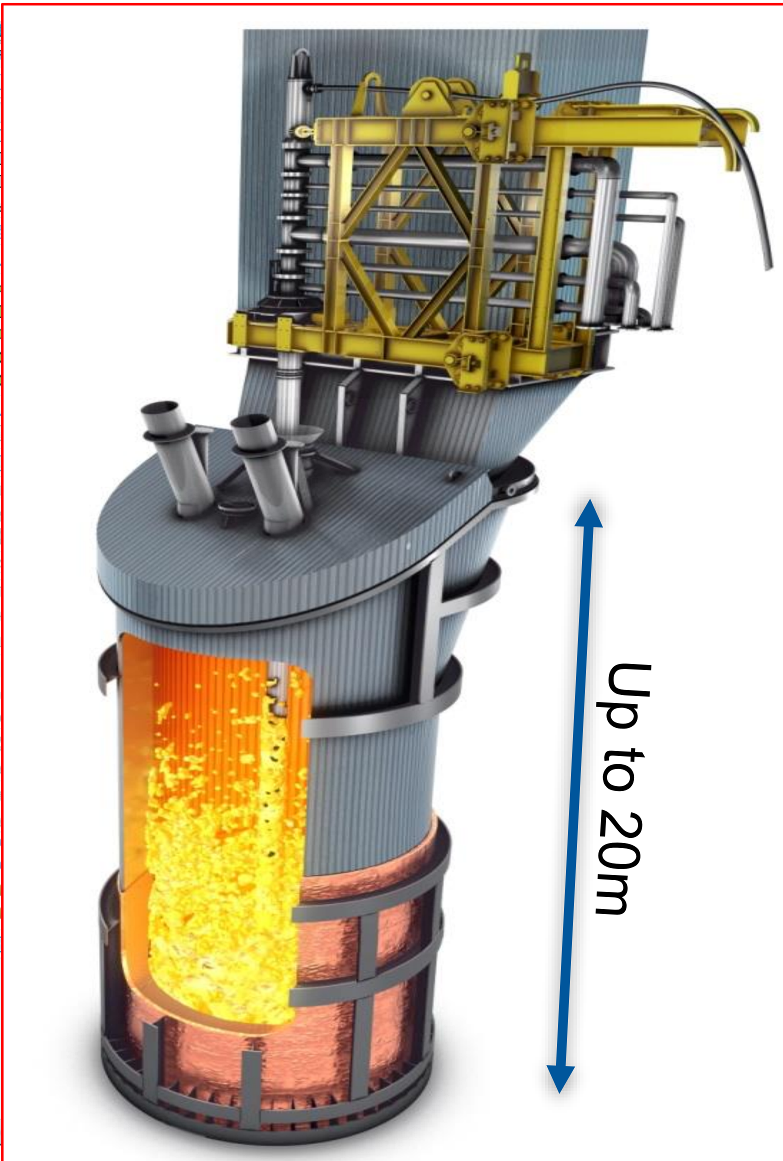
Prof. Dr. Dr. h.c. Markus A. Reuter
Helmholtz Institute Freiberg for Resource Technology©

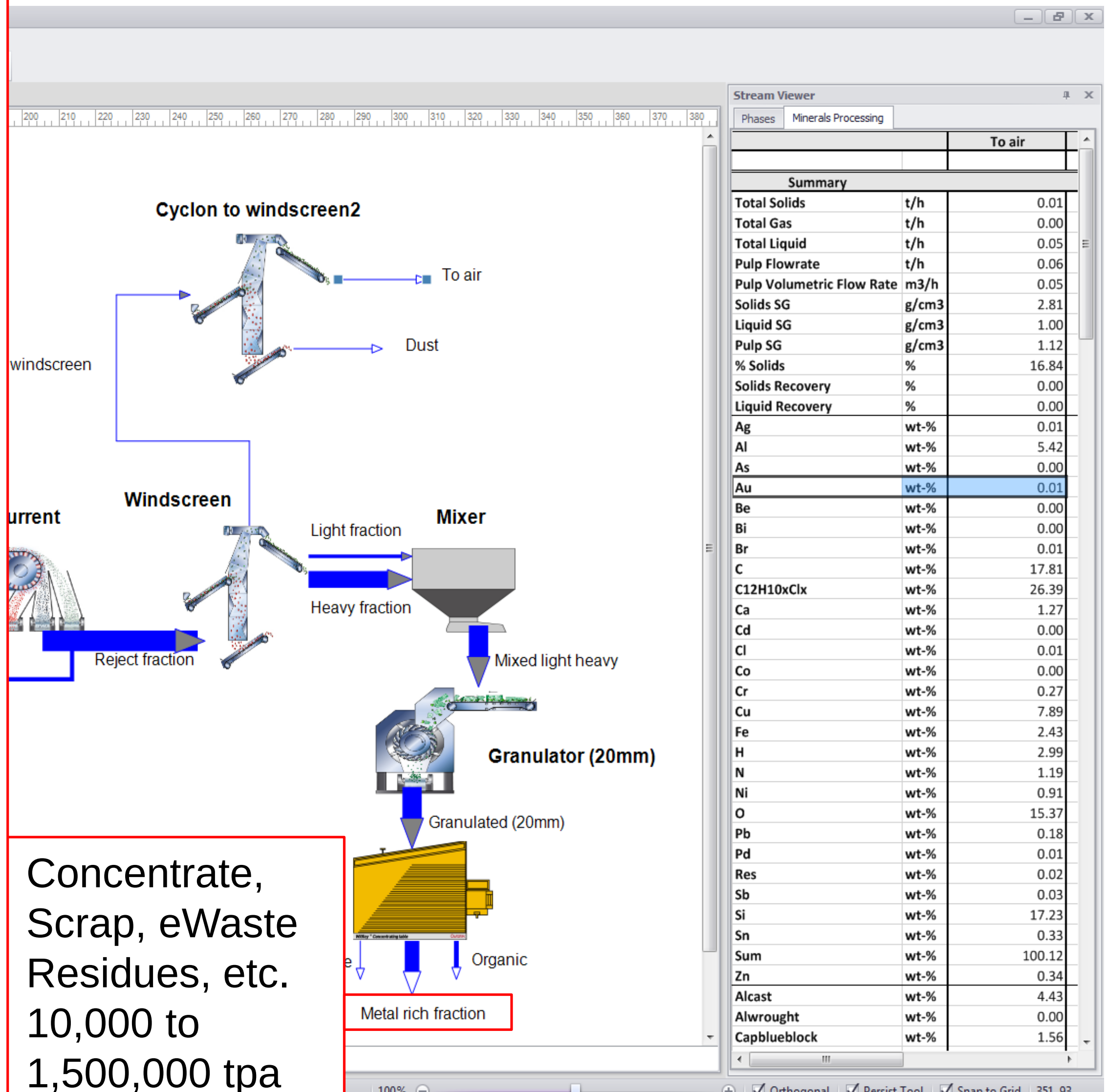
Circular Economy Engineering – The tools…



M.A. Reuter, A. van Schaik, J. Gediga (2015): International Journal of Life Cycle Assessment, 20(5), 671-693.

Circular Economy Engineering – The tools…

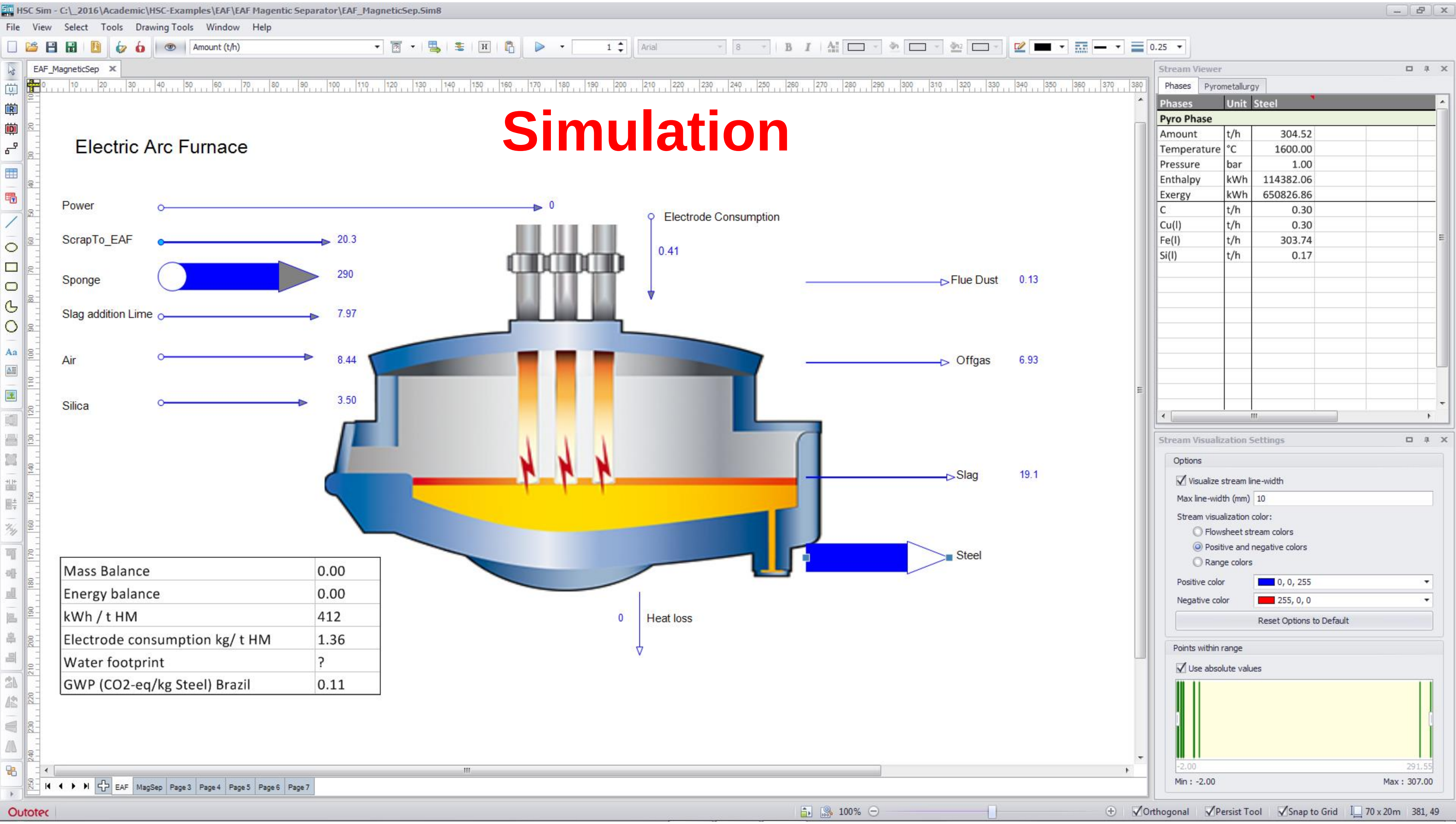




Concentrate, Scrap, eWaste Residues, etc.
10,000 to 1,500,000 tpa

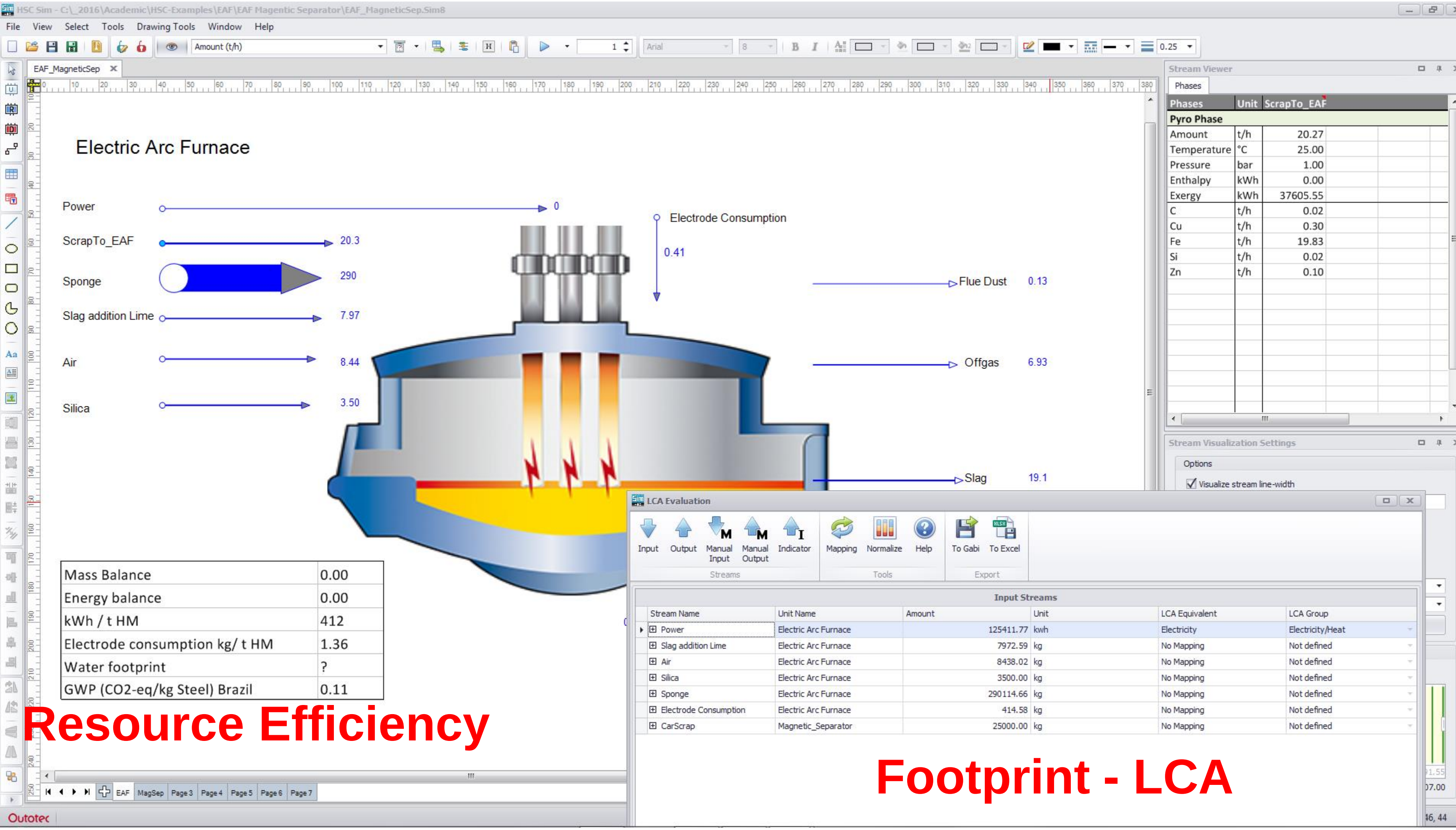
M.A. Reuter, A. van Schaik, J. Gediga (2015): International Journal of Life Cycle Assessment, 20(5), 671-693.

Resource efficiency of industrial systems



Prof. Dr. Dr. h.c. Markus A. Reuter
Helmholtz Institute Freiberg for Resource Technology©

Resource efficiency of industrial systems



Prof. Dr. Dr. h.c. Markus A. Reuter
Helmholtz Institute Freiberg for Resource Technology©

Resource efficiency of industrial systems - Copper

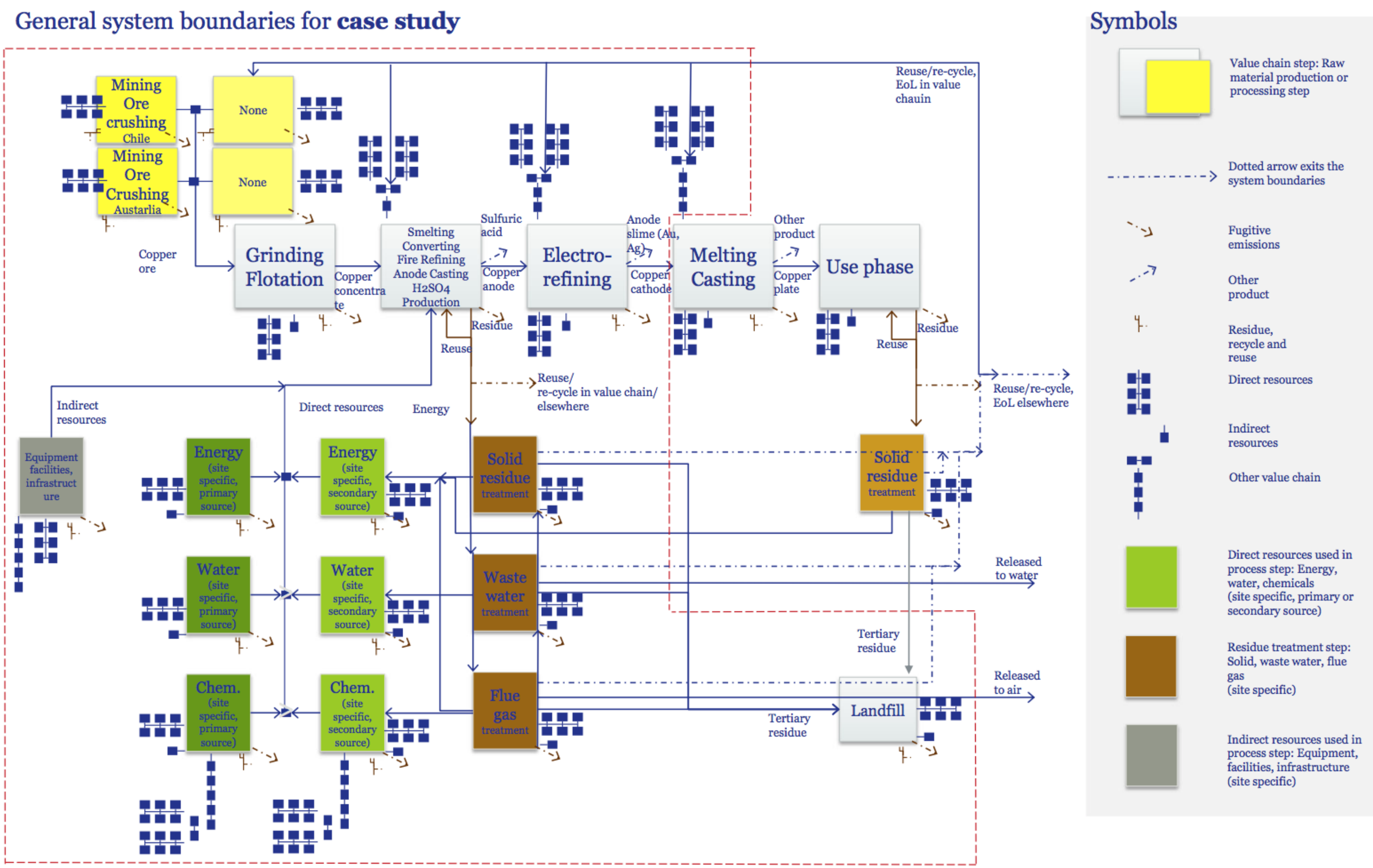
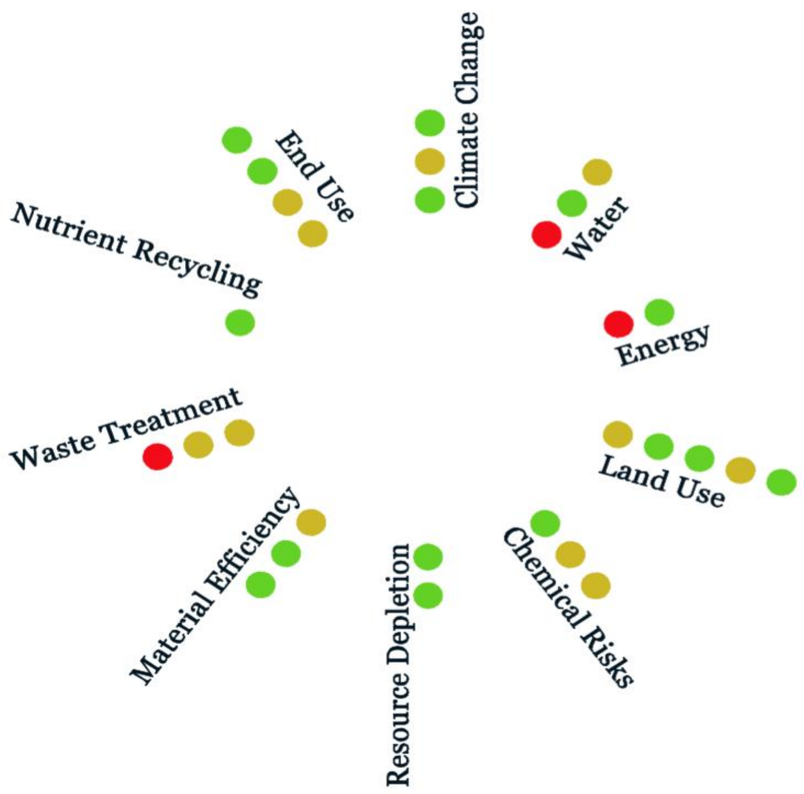


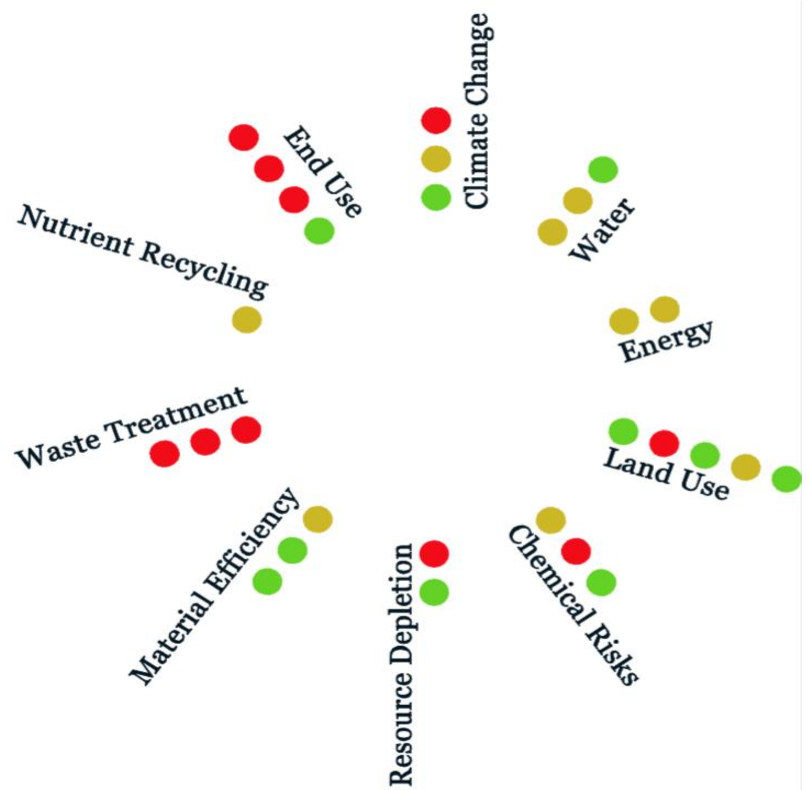
Fig. 1 The scope of the analysis is signified by the *golden dashed line*

Quantifying Resource Efficiency

Footprint of industrial solutions relative to baseline



Copper System 1

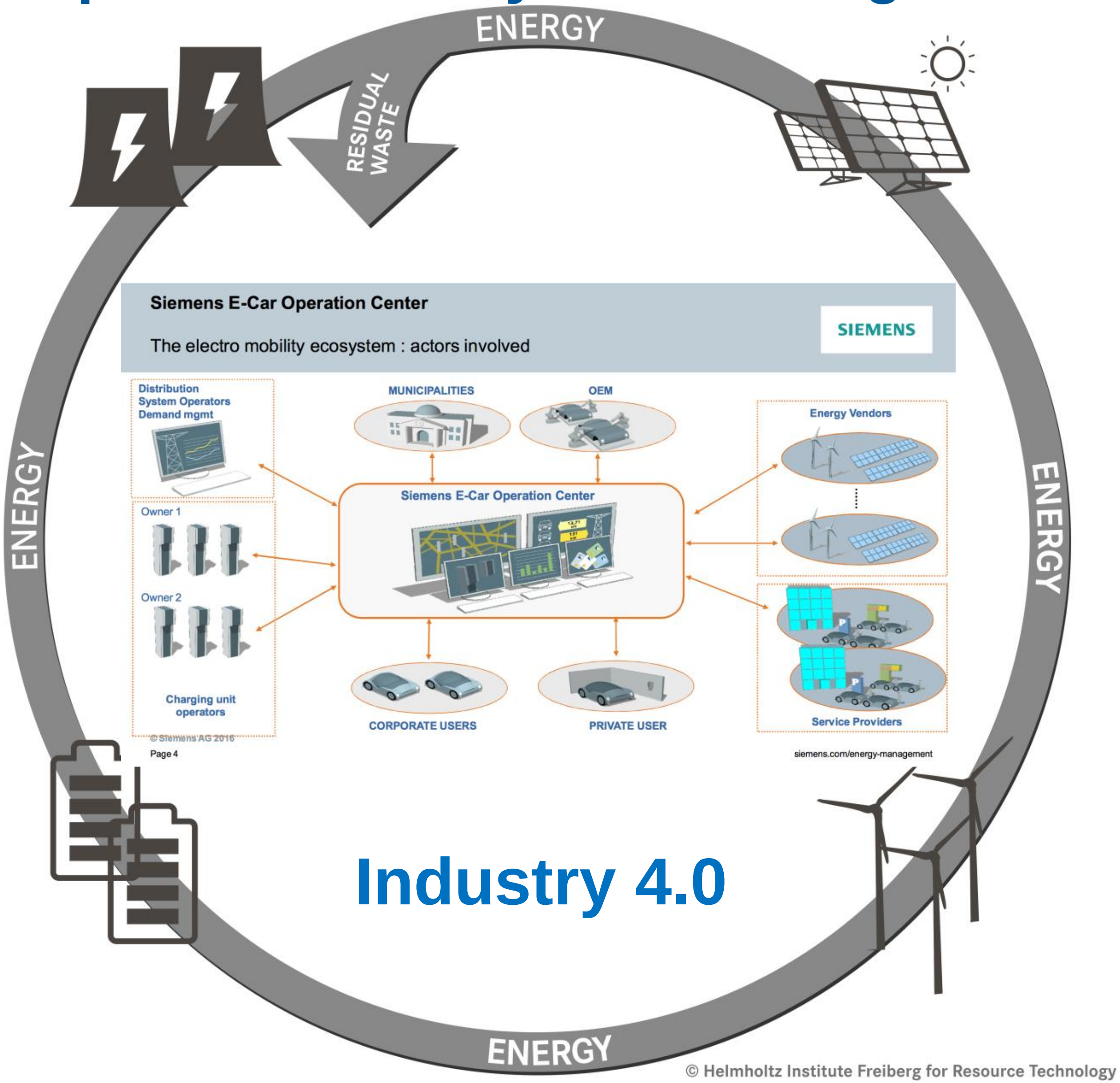


Copper System 2

- Potential competitive advantage
- Neutral
- Potential risk

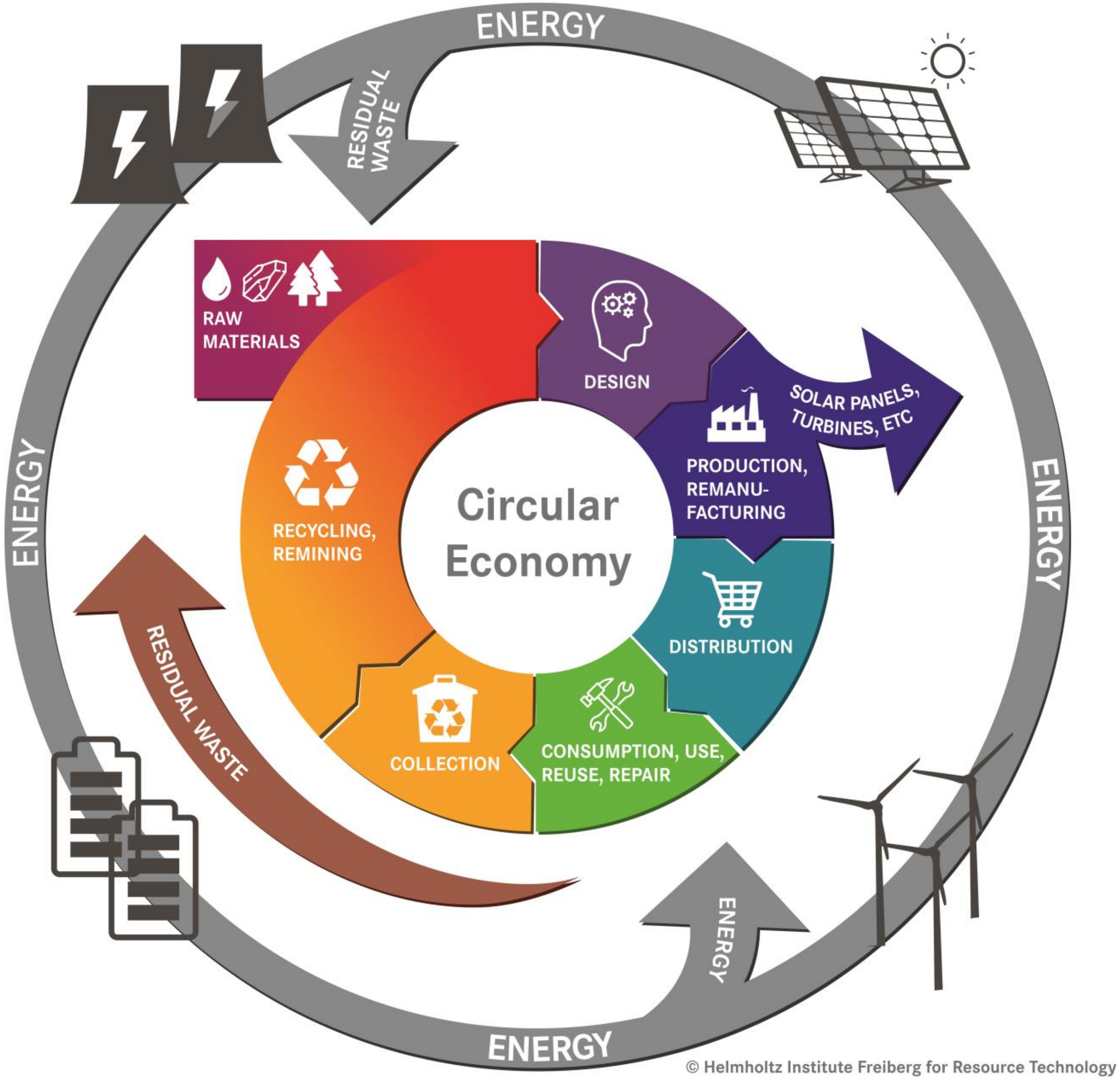
I. Rönnlund, M.A. Reuter, S. Horn, J. Aho, M. Päällysaho, L. Ylimäki, T. Pursula (2016): Sustainability indicator framework implemented in the metallurgical industry: Part 1-A comprehensive view and benchmark, Part 2-A case study from the copper industry, International Journal of Life Cycle Assessment (online).

Has anybody spoken about the footprint & embodied energy impact of Industry 4.0? Ecological break-even?



Prof. Dr. Dr. h.c. Markus A. Reuter

Circular Economy: Optimizing Resource Efficiency



Prof. Dr. Dr. h.c. Markus A. Reuter