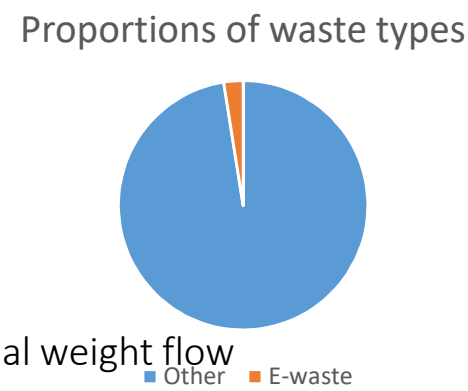
Strategies and technologies for improving material efficiency

By Dr. Anders S.G. Andrae (Huawei)

13th ***Symposium on ICT, Environment and Climate Change***, Session 3: The Impacts of E-waste on Climate Change and Moving to a Circular Economy, Geneva, Switzerland, 13 May 2019.

Setting the stage – some issues in the field of material efficiency

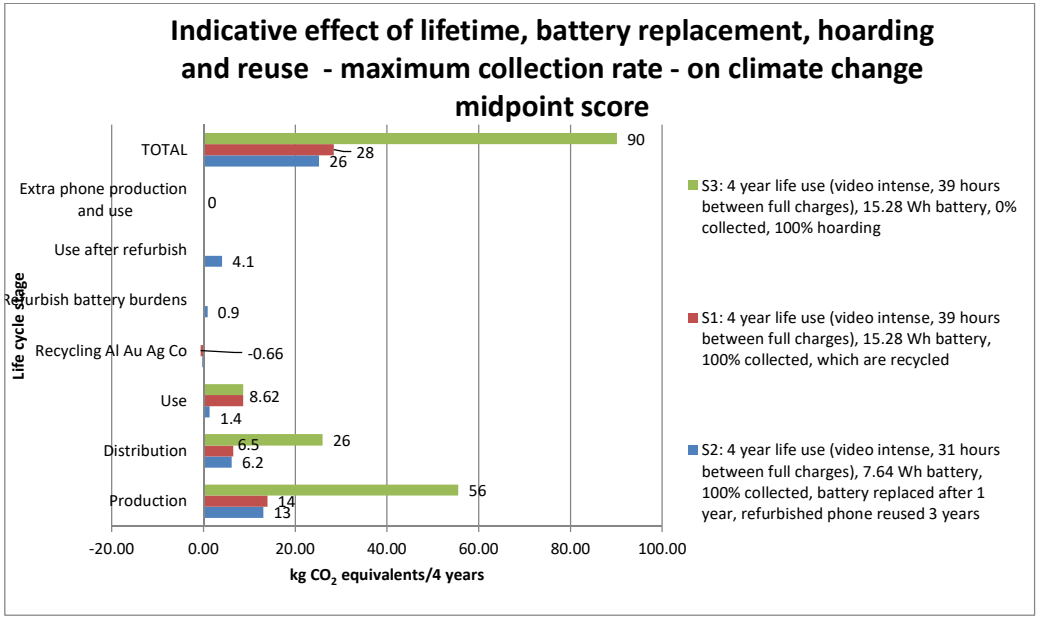


- 99% of everything that we buy becomes waste after 6 months.
- 2 billion tonnes of waste (garbage) is generated annually of which 2.5% is e-waste.
- Total Material Consumption per capita is increasing. Effective material flow >> conventional weight flow
- Total Material Requirements / kg metal is increasing – ore grades... The focus is on local waste/capita
- Ore grade (COPPER) is gradually decreasing 2.5% per annum, while production and energy consumption (and GHG emissions) from mining is increasing.
- Materials have become cheap compared to labour. Still, less waste (=more circularity) is important for cost, social cost, emission reduction, biodiversity, and water pollution
- Nowadays, it is generally possible to buy cheaper new products than repairing older ones.
- Robust life cycle assessment (LCA) with primary data is not used extensively to inform decision making → suboptimization

Relevant work for strategy - standardization

ITU-T Study Group 5 has a vital standardization process for resource efficiency.

- ❑ L.1021 (Extended producer responsibility)
- ❑ ITU-T L.Suppl.28 (Concepts for CE in ICT)
- ❑ L.CE (Guide to of Material Efficiency in ICT)
  -Need for specific RRR Calculation methods.
- ❑ L.1015 (”Green Criteria for mobile phones”)
  -Theoretically, remanufacturing and comprehensive refurbishment can reduce GHG emissions between 79-99% in selected sectors



Annual GHG emission saving potential of recycling metals in smartphones: ≈1 million tonnes, Global energy related GHG emissions 33100 million tonnes in 2018.

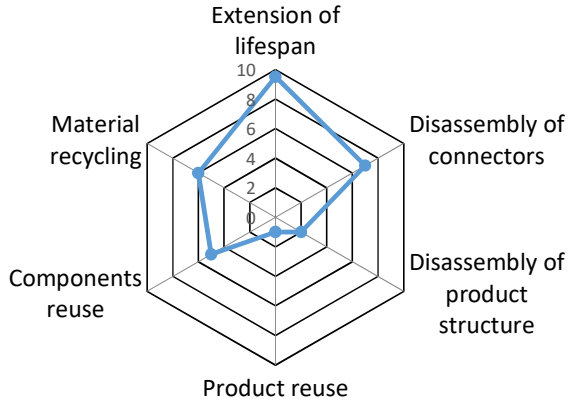
Relevant technologies – AI is key

- AI software for optimization is likely a more fruitful route than new waste management technologies
- Product design:
  - AI prediction of product design variables for emission reduction and customer relevance

- Smart logistics (improvements in route planning) by AI

- Mobile collection of e-waste on demand

- Intelligent optical sorting machines

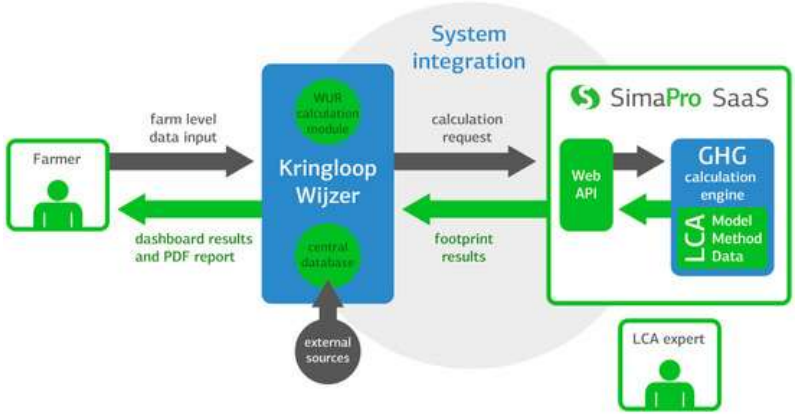


- The effectiveness of AI to achieve savings depends greatly on sufficient data and the data scientists and engineers developing the AI software?

- AI has successfully been employed for forecasting the volume of waste which will be generated→ proper planning of landfill sites, recycling units, development as well as operation of garbage collection infrastructure

- AI can cope especially well with historical data which are of nonlinear nature

What to do? humans + AI



Craft effective policy based on scientific evidence AND market friendliness.

Need for standards and precedures e.g. for dismantling and scrapping centres

- Perform rigor LCA easier with tools like ”SimaPro as A Service” so we can trust the outcome for decision making e.g. for material efficiency
- In-house IT systems connected via AI – create opportunities for cost saving, emission saving and less waste
- Use the new technologies for LCA+AI → rapid decision support for designers and customer information.

What performance is good enough for a certain application?

➢ Na-ion batteries (90-115 Wh/kg) instead of Li-ion (100-265 Wh/kg)?

❑ The global material efficiency/waste problem is mainly not solved effectively by improved local waste management (e.g. collection) but by AI optimization of total global supply chains which minimize waste in production and TMC/capita

❑ Optimizing/Predicting the whole nonlinear global societal system with ICT as a driver – Markets, Input-Output, Emissions, Resources, Costs, Jobs, Waste – is a daunting task which theoretically could better be managed with Artificial Intelligence (AI) AND humans instead of humans alone.

References to reflect upon

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