

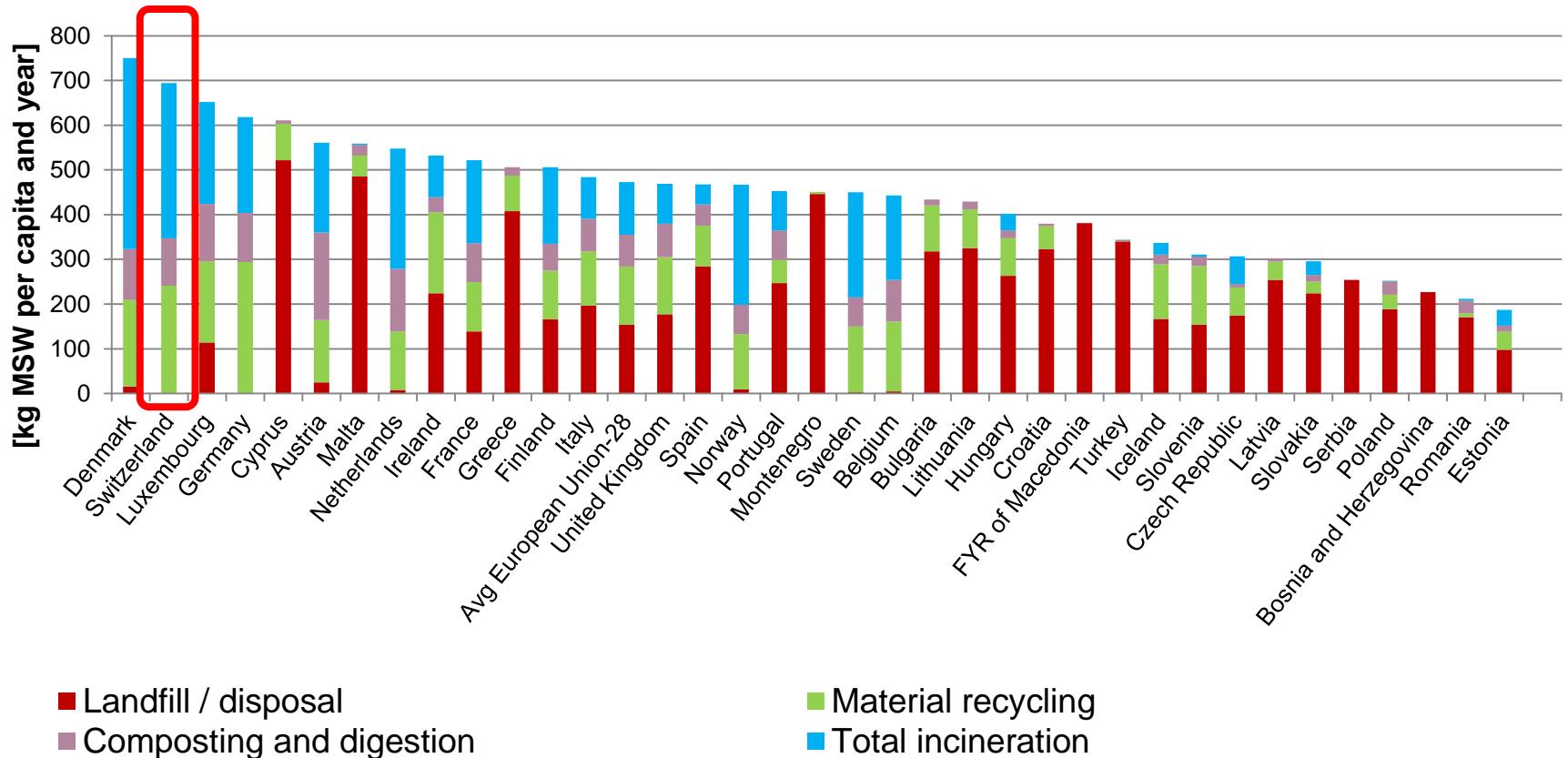


# Managing waste for an efficient and clean Circular Economy

**Stefanie Hellweg**

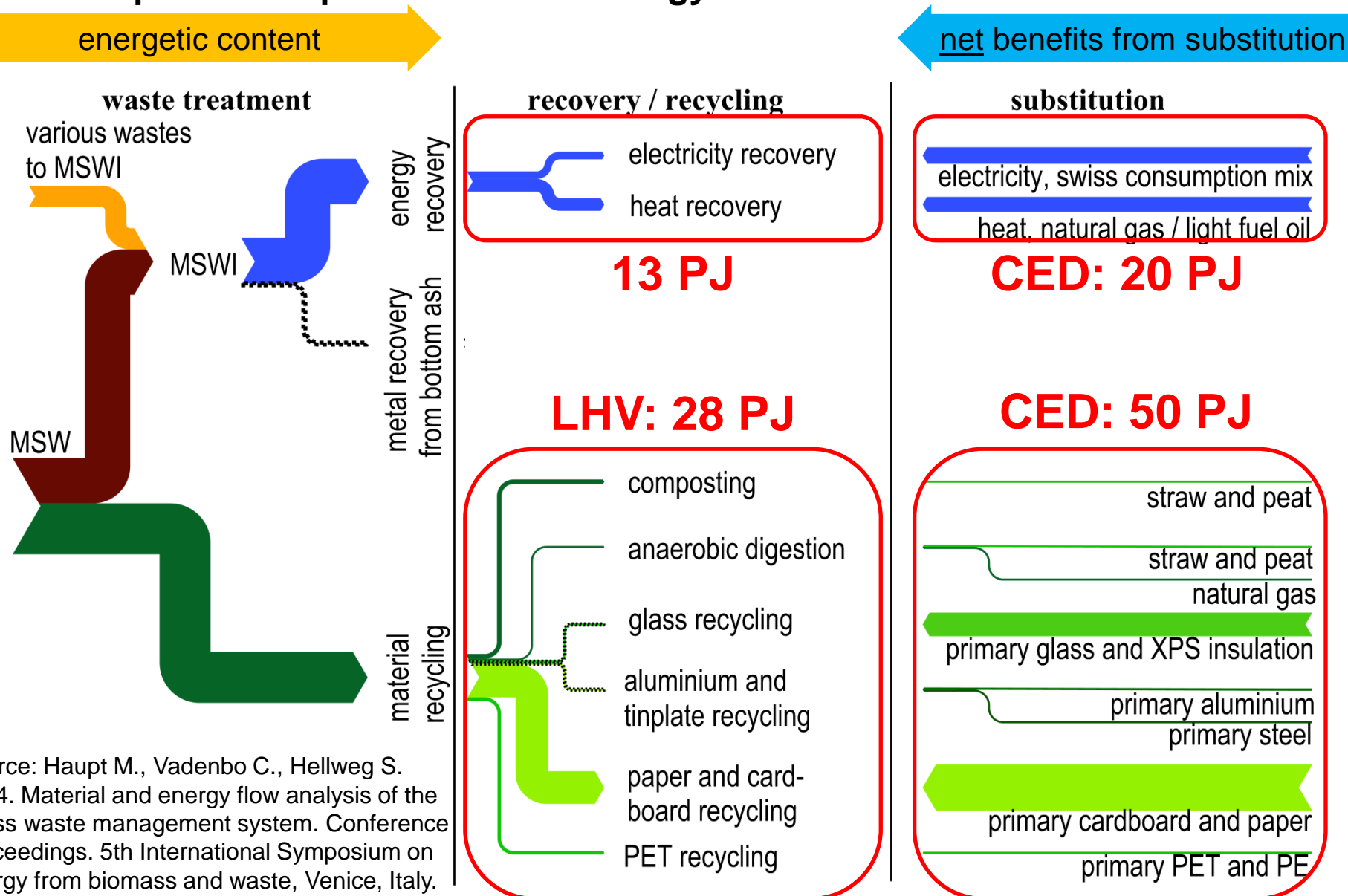
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# Per capita municipal solid waste (MSW) amounts and disposal pathways in Europe (2012)



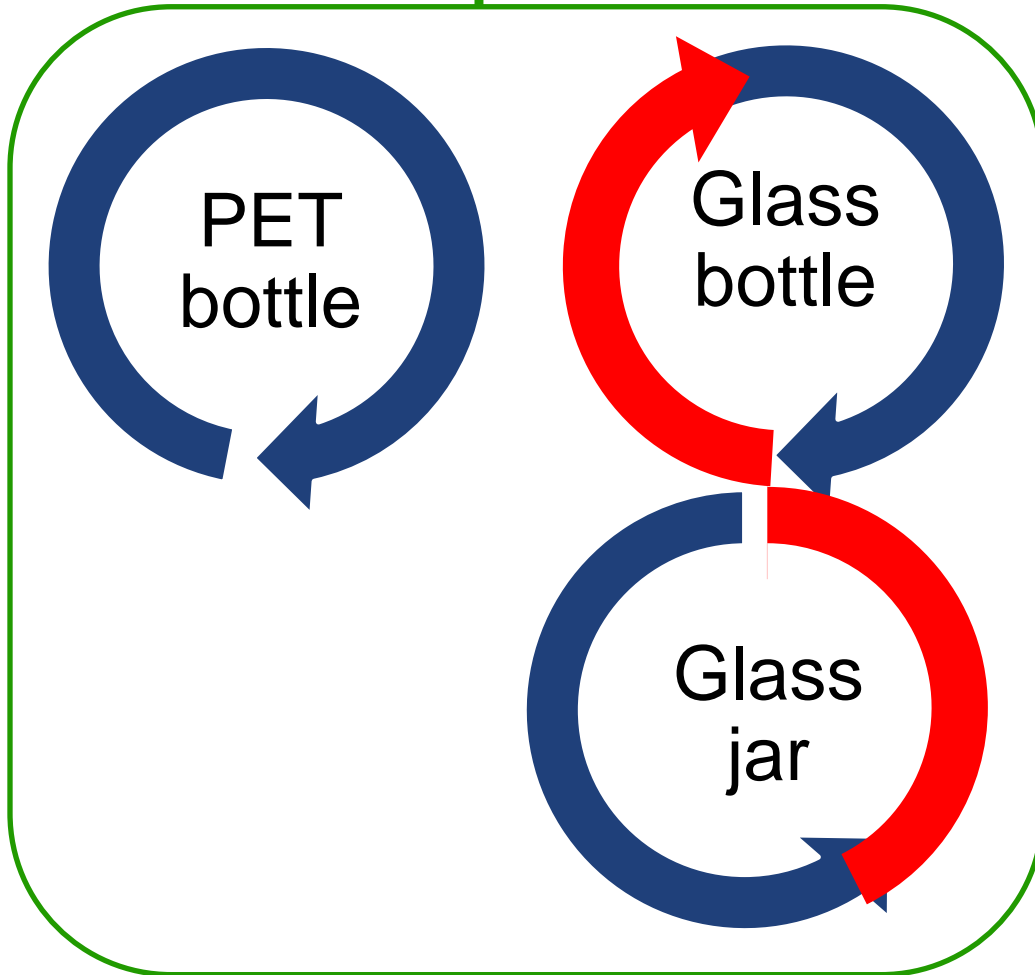
Source: Dataset '[tsdpc240] - Municipal waste generation and treatment, by type of treatment method - kg per capita'; retrieved from <http://ec.europa.eu/eurostat/web/environment/waste/main-tables>

## Example: Municipal Solid Waste energy flows in Switzerland

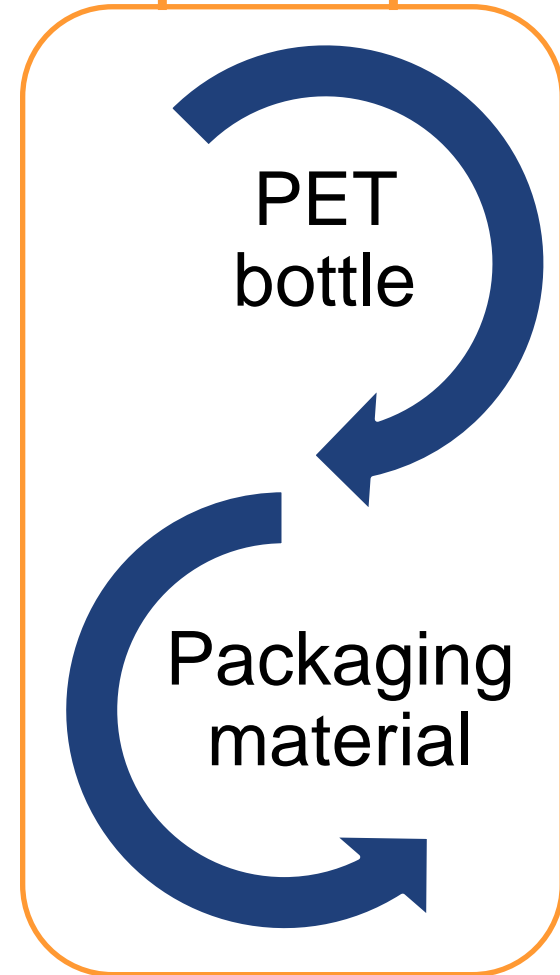


# Closed-loop vs. open-loop recycling

closed-loop



open-loop





# Collection rates (CR) vs. Recycling rates (RR)

*The comparison of collection and recycling rates for Switzerland shown during the presentation will be available soon in:*

*Haupt, M., C. Vadenbo, and S. Hellweg. Do we have the right performance indicators for the circular economy? – Insight into the Swiss waste management system. Journal of Industrial Ecology. In Press.*

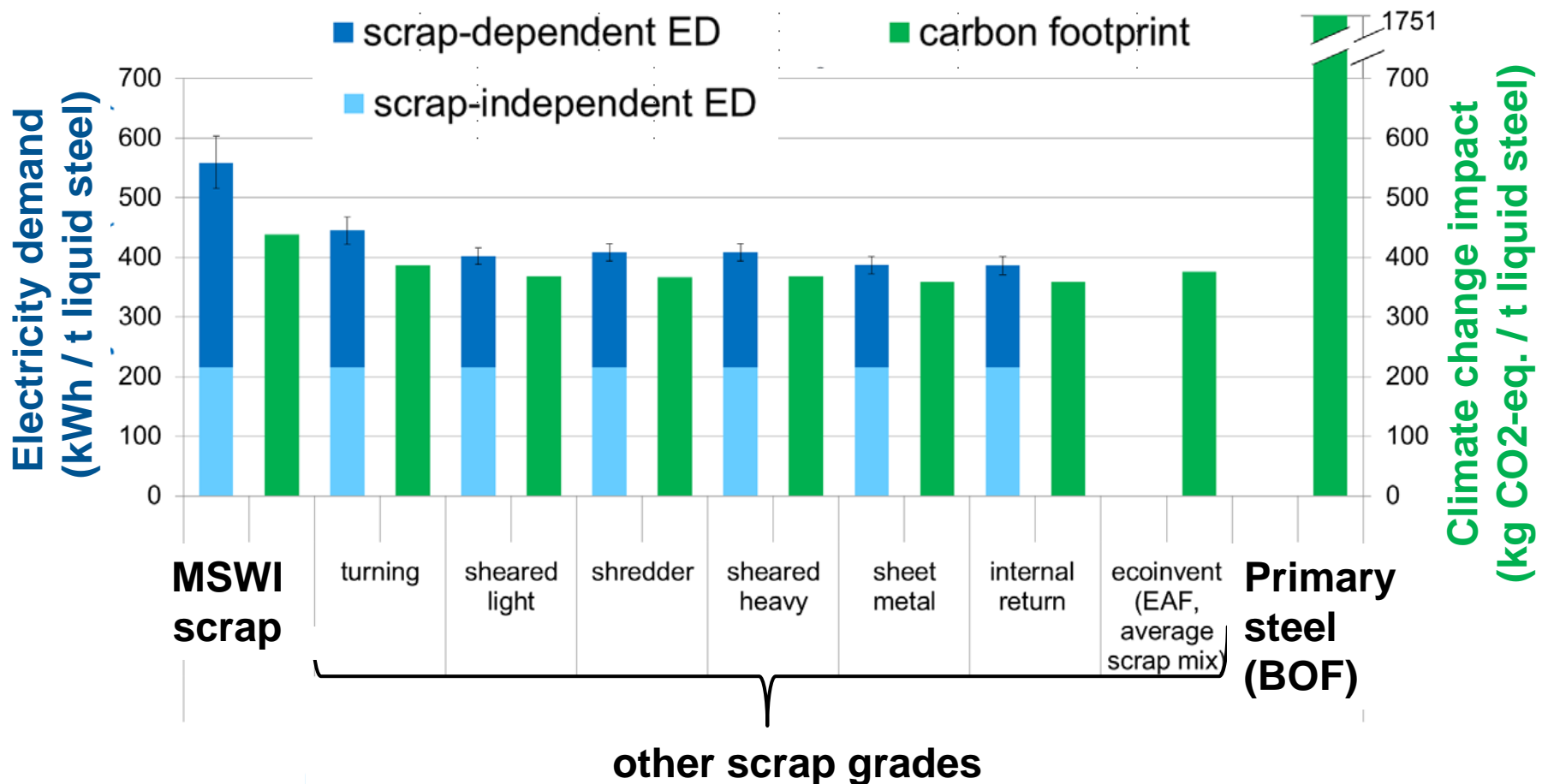


# Conclusions

- Recycling rates should be net of all losses (as far as possible).
- Environmental impacts of various recycling processes vary and should be considered when defining recycling targets.
- Improvement potential both in terms of quantity and quality of recycling exists even in «waste-frontrunner» countries.



# Influence of resource quality on environmental impacts (example steel recycling from MSWI bottom ash scrap)

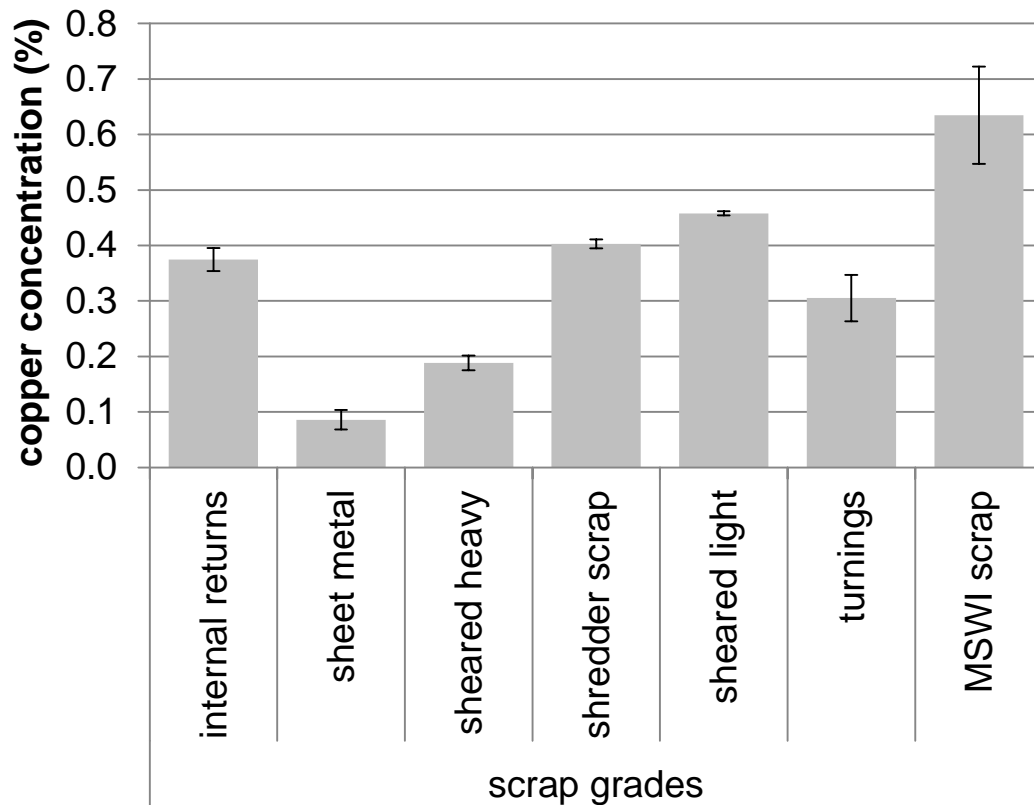


# Separate collection vs. recovery after MSWI





# Copper in ferrous scrap recycling



- low quality scrap adds copper that cannot be removed from molten steel → accumulation in steel cycle
- copper hardens the steel and is detrimental for the carbon steel quality
- cannot be recycled as copper once lost in the carbon steel cycle

→ “Clean cycles” (Kral et al. 2013)

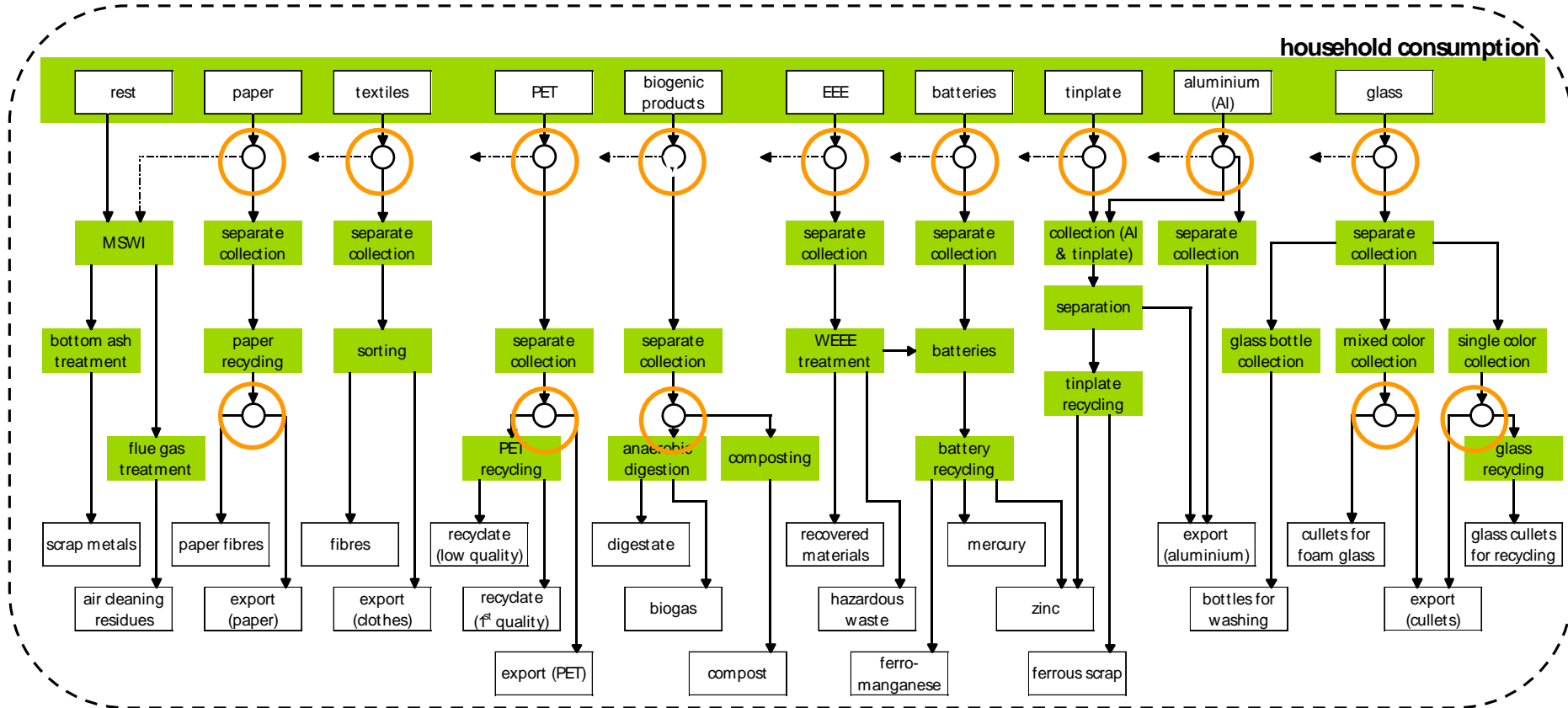


# Conclusions

- The quality of waste materials influences the potential use of recycling products, the environmental impacts and (hazardous) pollutant concentrations of recycling products.
- Increasing the quality (better sorting, optimized pre-processing, optimizing blending etc.) can lead to significant savings in energy and environmental impact
- Data gaps on the influence of resource quality on the recycling process are large.



# Outlook: Optimization of MSW management



MFA

LCA

Optimization

# Take-home messages



- **Recycling ≠ recycling**
  - Recycling alternatives differ in environmental benefits and impacts.
  - Targets need to be designed carefully to provide meaningful incentives (RR should consider all losses and be determined based on environmental benefits and impacts).
- **Quality matters!** Waste material quality ...
  - may restrict the potential use of recycled products,
  - influences environmental impacts of the recycling process (e.g. energy demand)
  - may lead to hazardous exposure through follow-up products.
- **Industrial Ecology Tools can guide the way.** Combination of MFA and LCA can be used...
  - for comprehensive optimization of resource/waste management systems,
  - to reveal trade-offs,
  - as basis to derive resource strategies



# Thank you!

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