# Balancing sustainability and access to raw materials

## Focus: Significance & recycling of technology metals

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# Minute content per unit, but volume counts

## Example: Metal use in electronics

**Global sales, 2009**

**a) Mobile phones**

1300 million units/ year

| | | | | | |
|---|---|---|---|---|---|
| X250 | mg | Ag | ≈ | 325 t | Ag |
| X 24 | mg | Au | ≈ | 31 t | Au |
| X 9 | mg | Pd | ≈ | 12 t | Pd |
| X 9 | g | Cu | ≈ | 12,000 t | Cu |

1300 million Li-Ion batteries

| | | | | | |
|---|---|---|---|---|---|
| X 3.8 | g | Co | ≈ | 4900 t | Co |

**b) PCs & laptops**

300 Million units/year

| | | | | | |
|---|---|---|---|---|---|
| X1000 | mg | Ag | ≈ | 300 t | Ag |
| X 220 | mg | Au | ≈ | 66 t | Au |
| X 80 | mg | Pd | ≈ | 24 t | Pd |
| X~500 | g | Cu | ≈ | 150,000 t | Cu |

~140 million Li-ion batteries

| | | | | | |
|---|---|---|---|---|---|
| X 65 | g | Co | ≈ | 9100 t | Co |

**a+b) Urban mine**

Mine production / share

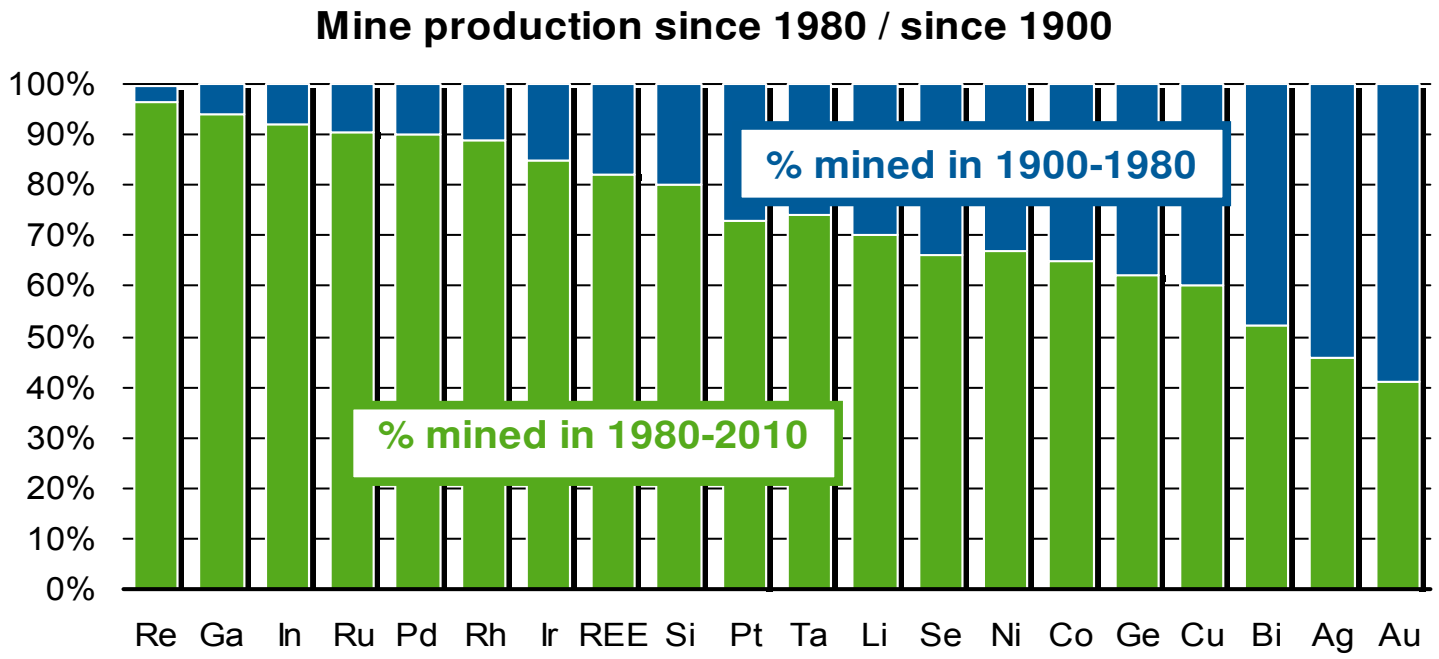
| | | | | |
|---|---|---|---|---|
| Ag: | 21,000 | t/a | ► | 3% |
| Au: | 2,400 | t/a | ► | 4% |
| Pd: | 220 | t/a | ► | 16% |
| Cu: | 18 | Mt/a | ► | <1% |
| Co: | 75,000 | t/a | ► | 19% |

Tiny metal content per piece → Significant total demand

Cumulated global sales of mobile phones worldwide until end 2010: ~ 10 Billion devices

Other electronic devices add even more to these figures

# Recent boom in demand for most technology metals



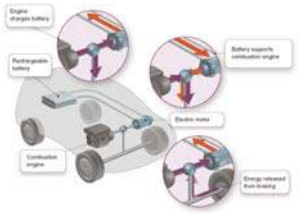

REE = Rare Earth Elements

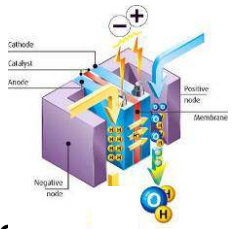
A significant portion of these metals is still locked in the technosphere

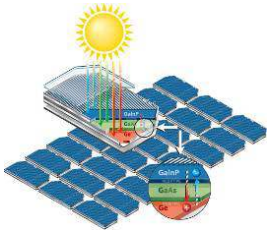
# Emerging technologies will further boost demand for technology metals

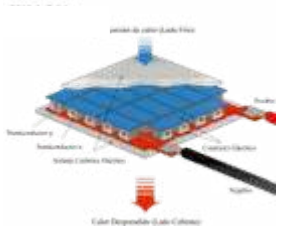
Multiple examples:

- Electric vehicles & batteries
  cobalt, lithium, rare earth elements, copper
- Fuel cells
  platinum, (ruthenium, palladium, gold)
- Photovoltaic (solar cells)
  silicon, silver, indium, gallium, selenium, tellurium, germanium
- Thermo-electrics, opto-electronics, LEDs, …
  bismuth, tellurium, silicon, indium, gallium, arsenic, selenium, germanium, antimony, …
- …







# Resource efficiency needed to deal with scarcity of technology metals

Demand is growing

- Global growth
- Demand for technology metals well above GDP
- Limited substitution possibilities

Supply is limited

- Worldwide primary supply (from mining) is limited
- Mining possibilities limited by the coupling of technology metals with base metals
- Mining creates geopolitical dependence
- Short term supply often impacted by speculation on commodities

⇒ **RECYCLING** is essential to preserve **RESOURCE EFFICIENCY**

# Urban mining “deposits” can be much richer than primary mining ores

**Primary mining**

- ~5 g/t Au in ore
- Similar for PGMs

**Urban mining**

- 200-250 g/t Au in PC circuit boards
- 300-350 g/t Au in cell phones
- ~2000 g/t PGM in automotive catalysts

# Smart recycling

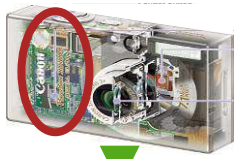
## quality more important than quantity

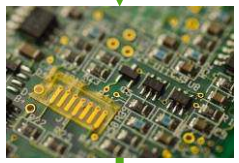
**Bottle glass**


**Green glass**
**White glass**
**Brown glass**

**Steel scrap**

**Circuit boards**





**Specialty metals**

**Autocatalysts**

**PGMs**

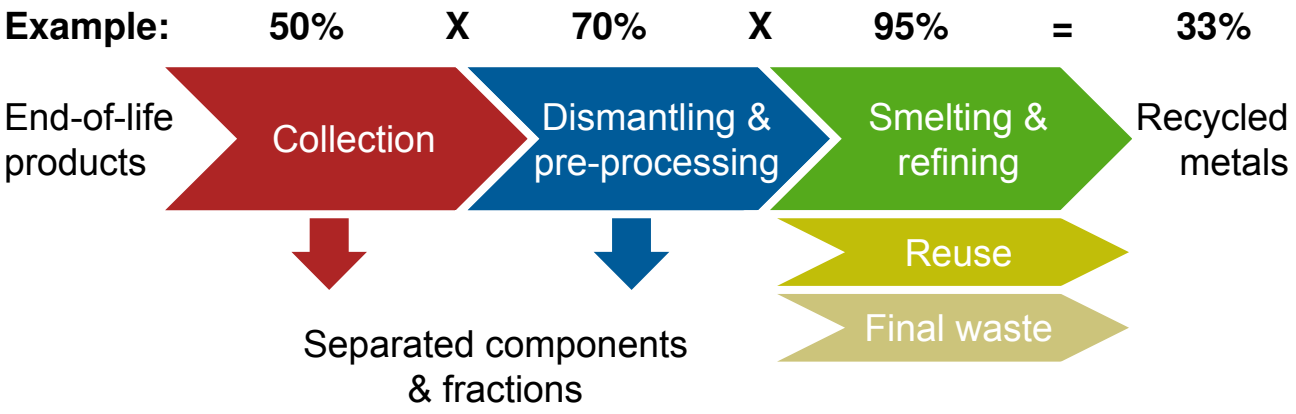
- "Mono-substance" materials without hazards
- Trace elements remain part of alloys/glass

**Recycling focus on mass & costs**

- "Poly-substance" materials, incl. hazardous elements
- Complex components as part of complex products

**Focus on trace elements & value**

# Recycling chain- system approach is key




- Consider the entire chain & its interdependences
- Precious metals dominate economic & environmental value ⇒ minimise PM losses
- Mass flows ≠ flows of technology metals
- Success factors ⇒ interface optimisation, specialisation, economies of scale

⇒ **The total recycling efficiency is determined by the weakest step in the chain**

# Large number of players in the recycling chain feed to small number of technology metal refiners

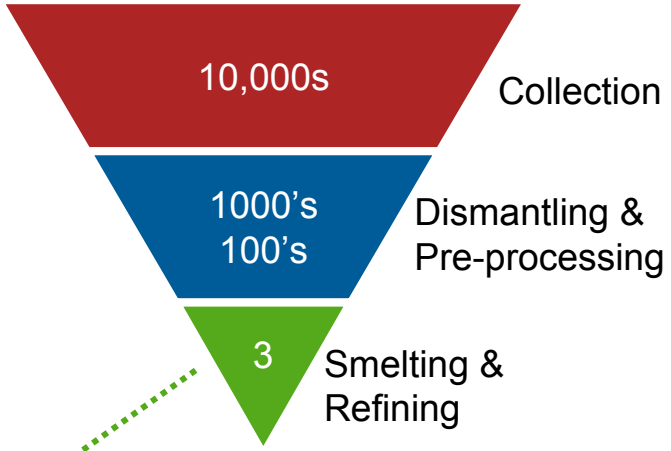
Sufficient capacity for recovery of technology metals available

Make sure that critical fractions reach these plants

Ensure that critical fractions with technology metals are treated at BAT processes

- High yields, minimal emissions
- Recovery of multiple metals

**Example e-scrap: Number of actors in Europe**




SMEs play important role in collection, dismantling & pre-processing, but final metallurgical (technology) metals recovery requires large scale operations & huge investments

# High Tech & Economies of Scale - crucial for success


- Focus PM-containing secondary material, input > 300 000 t/a, global customer basis
- Recovery of 17 metals: Au, Ag, Pt, Pd, Rh, Ru, Ir, Cu, Pb, Ni, Sn, Bi, Se, Te, Sb, As, In.
- Investments since 1997: 500 M €; Invest. for comparable green field plant: >> 1 Bn €!
- Value of precious metals enables co-recovery of specialty metals ('paying metals')

# Main flaws in European recycling
## - relevant fractions don‘t reach best suited plants

a) Poor collection





b) “Deviation” of collected products
⇨ dubious exports ⇨backyard treatment



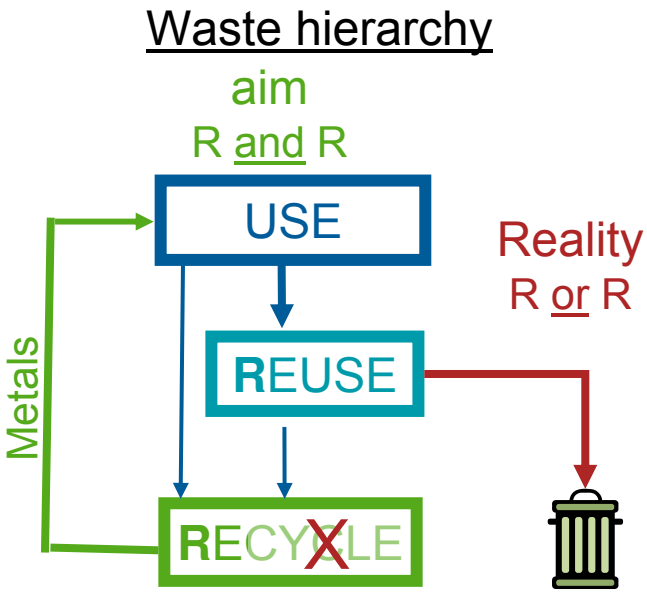



Au yield ≈ 25%

# Example mobile phone
## – little recycling in spite of available hi-tech processes

Recycling potential (2009, global): 800 M units / 80,000 t

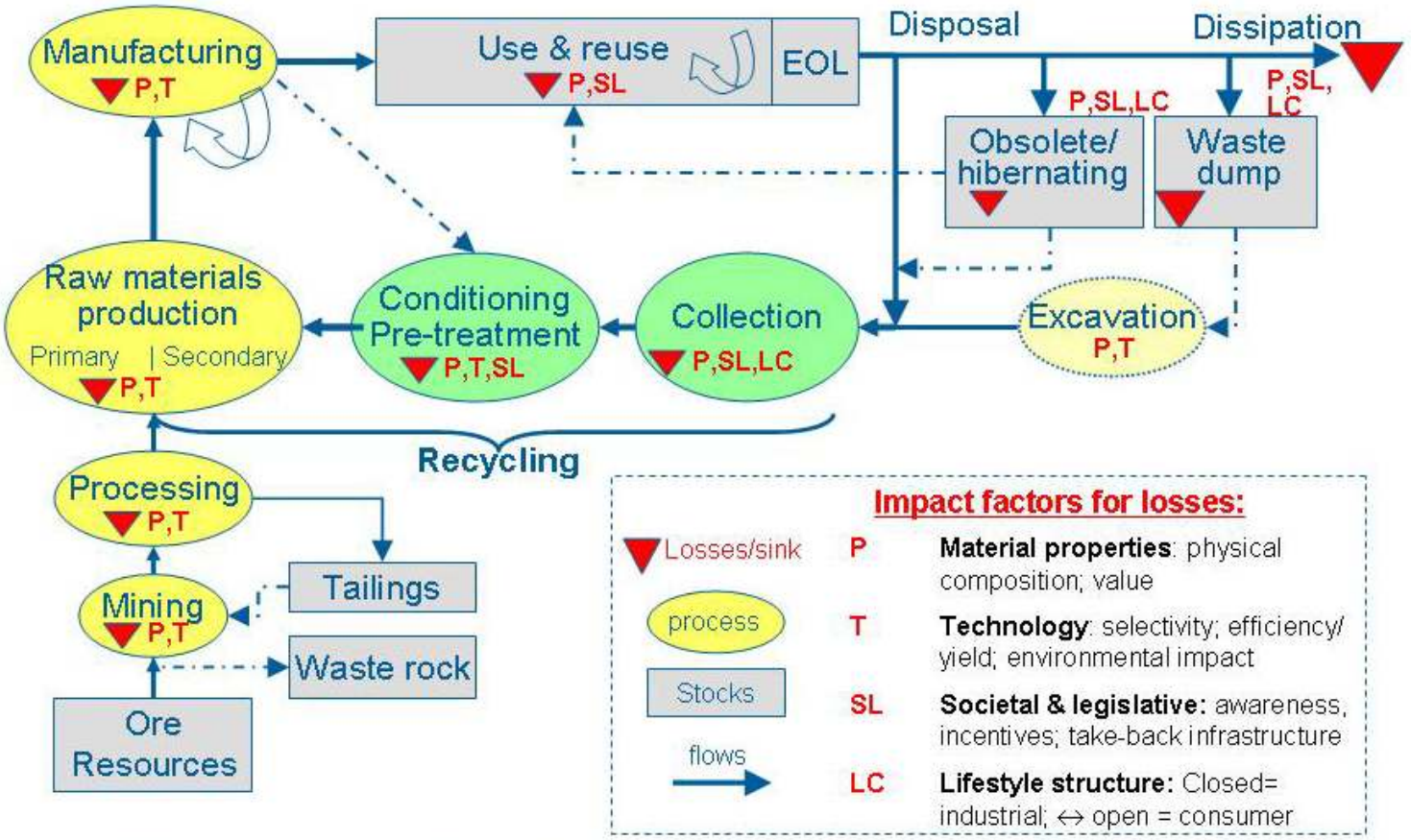
- Reality < 2.000 t
- Most phones are not collected (“drawer & waste bin”)
- Most collected phones are exported for “reuse” in developing/transition countries
- Usually no recycling at final end-of-life



# The recycling success depends on various impact factors on different levels

1. Technical recyclability = basic requirement
   (→ material composition, available technology)
2. Accessibility of relevant components (e.g. catalysts, circuit boards, batteries)
3. Economic recyclability:
   - intrinsic (e.g. car catalyst, jewellery) or
   - Externally created (by policy) (e.g. beer bottle with depot or household waste)
4. The EoL-product needs to be collected
5. It must be directed into an appropriate recycling chain and remain therein
6. Technical-organisational optimal set-up of the recycling chain
7. Sufficient recycling capacities (at all levels of chain)

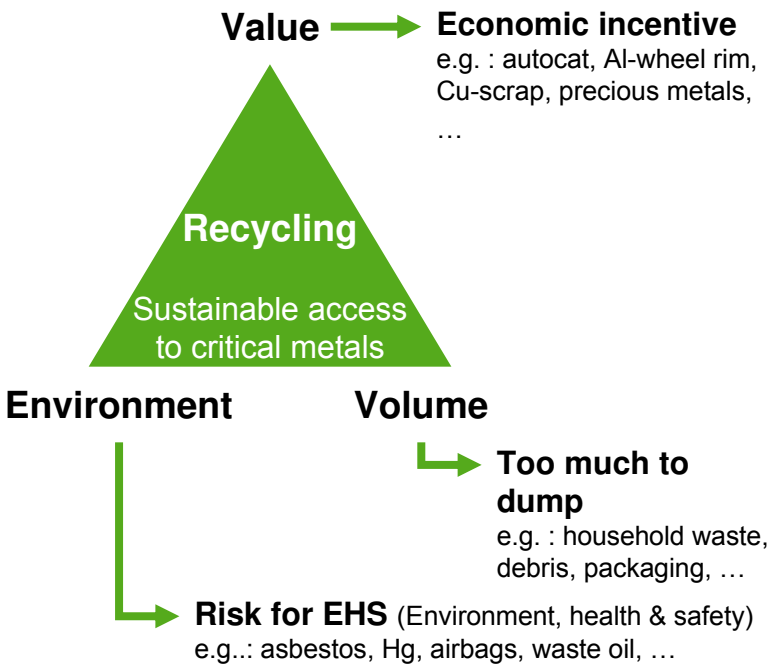
# Metal losses & impact factors along the product-/metal lifecycle




No „one size fits all" – tailored approaches needed per step

# Legislation needed for certain recycling drivers

## Criticality, a new driver for recycling?




## Current recycling-drivers

- Value:
  - Taken care of by the market, pays for itself
  - Set EHS frame conditions!
- EHS & volume
  - Society driven
  - Negative net value

**Driven by legislation**

## Future recycling drivers:

- "Critical metals"
  - Macro economic significance
  - Enhanced recycling worthwhile also without volume or EHS risks

# Urgent required actions to realize the full potential of the recycling chain

- Increase the collection of end-of-life products
- Prevent illegal & dubious exports of relevant end-of-life product
  - Improved enforcement of EU waste shipment regulation
- Create a level playing field internationally
  - Certification scheme for export of secondary raw materials
  - Re-shipping of complex End of Life products to “Best available technology” recycling plants
- Foster innovation in recycling technologies along the entire value chain

# Conclusion: Time for fundamental changes

- **Attitude**: Waste management ⇨ resource management
  - ➲ comprehensive collection, no dubious exports, global recycling approach
- **Targets**: Focus on mass ⇨ focus on quality & critical substances
  - ➲ system approach & prioritisation
- **Practice**: Traditional scrap business ⇨ high-tech recycling
  - ➲ adapt structures accordingly and provide global solutions
- **Vision:** burden ⇨ recycling as opportunity
  - ➲ creative business models to really close the loop (leasing, deposits, …)

⇨**Recycling requires a holistic & interdisciplinary approach**
***→ Ensure consistency between different EU policies***

⇨Recycling & mining are complimentary systems

# Thank you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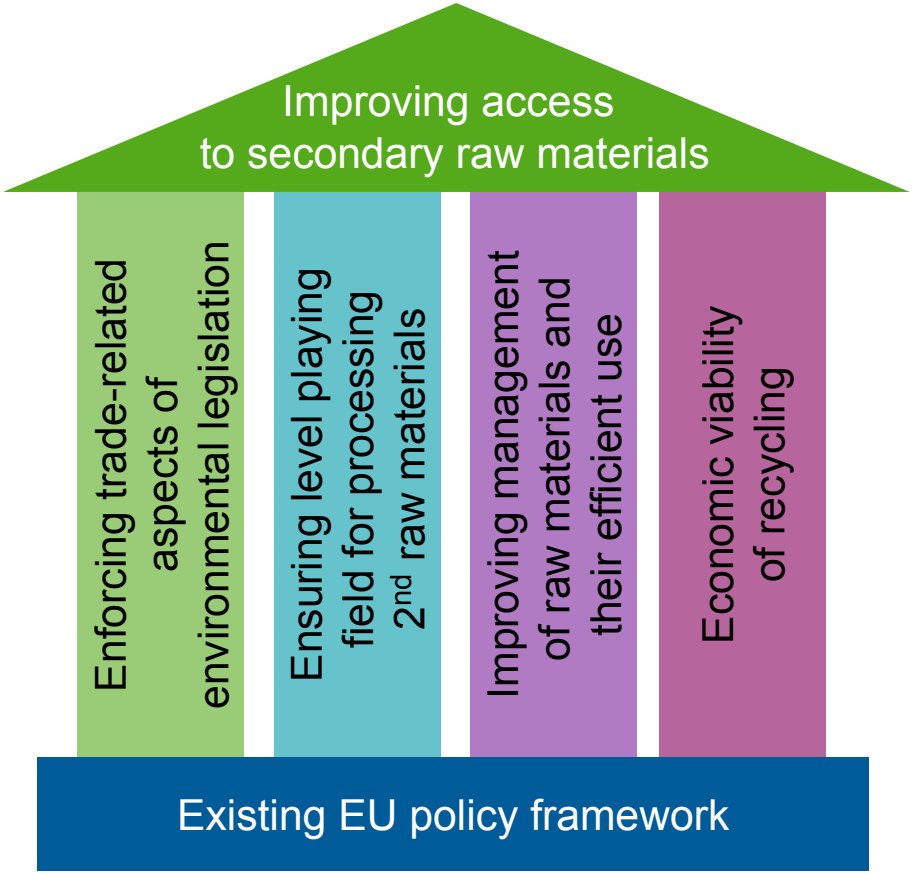
…it's about life !


More information: Hagelüken, C., C.E.M. Meskers: Complex lifecycles of precious and special metals, in: Graedel, T. , E. van der Voet (eds): Linkages of Sustainability. Strüngmann Forum Report, vol. 4. Cambridge, MA: MIT Press, 2010

# Eurometaux Proposals to Improve Access to Secondary Raw Materials




**10 concrete proposals under 4 pillars:**

**(1): Trade aspects**

- Customs identification of second hand goods
- Improved enforcement of Waste Shipment Regulation
- End-of-Waste

**(2) Level playing field**

- Certification scheme to ensure access to secondary RM
- Facilitate & encourage the re-shipping of complex materials to BAT-recycling plants in Europe

**(3) Improved EoL management**

- Promote the Efficient Collection and Recycling of Rechargeable Batteries
- The eco-leasing concept
- Better recycling data
- Research on recyclability

**(4) Economic viability of recycling**

**Download:**
www.oeko.de/publikationen/forschungsberichte/studien/dok/657.php?id=&dokid=1069&anzeige=det&ITitel1=&IAutor1=&ISchlagw1=&sortieren=&dokid=1069