WEEE recycling: key aspects in reducing the carbon footprint and providing access to scarce resources"

FORO
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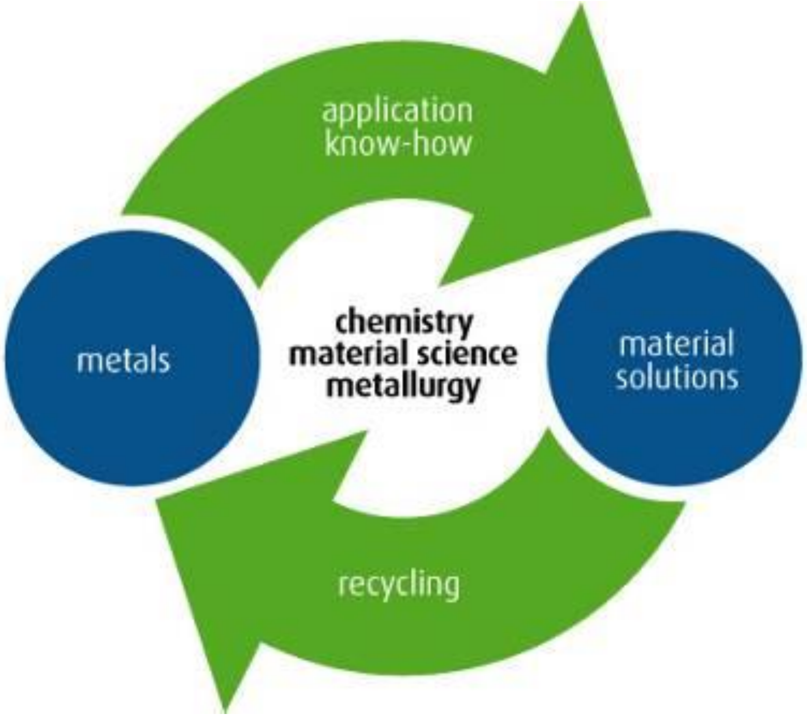
- Umicore Group
- Umicore Precious Metals Refining
- E-scrap: The recycling chain
- Challenges for Latin America
- Recommendations
- Conclusion

Material technology company with focus on clean technologies



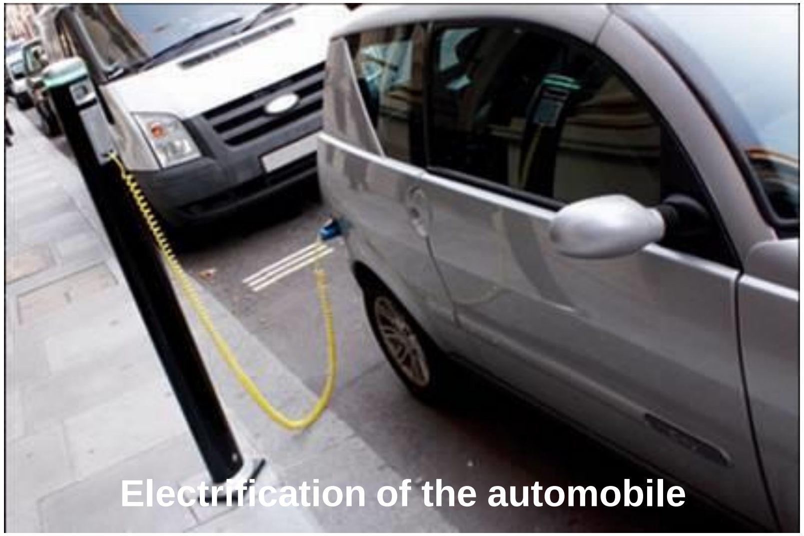
Global presence: 14,400 people in 80 industrial sites worldwide

Key megatrends for Umicore


Resource scarcity


More stringent emission control


Renewable energy


Electrification of the automobile

Umicore fit with megatrends

Electrification of the automobile

We are a leading producer of key materials for rechargeable batteries for laptops, mobile phones as well as electrified vehicles

Resource scarcity

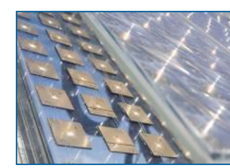
We are the largest recycler of precious metals; we are able to recycle more than 20 different metals

More stringent emission control

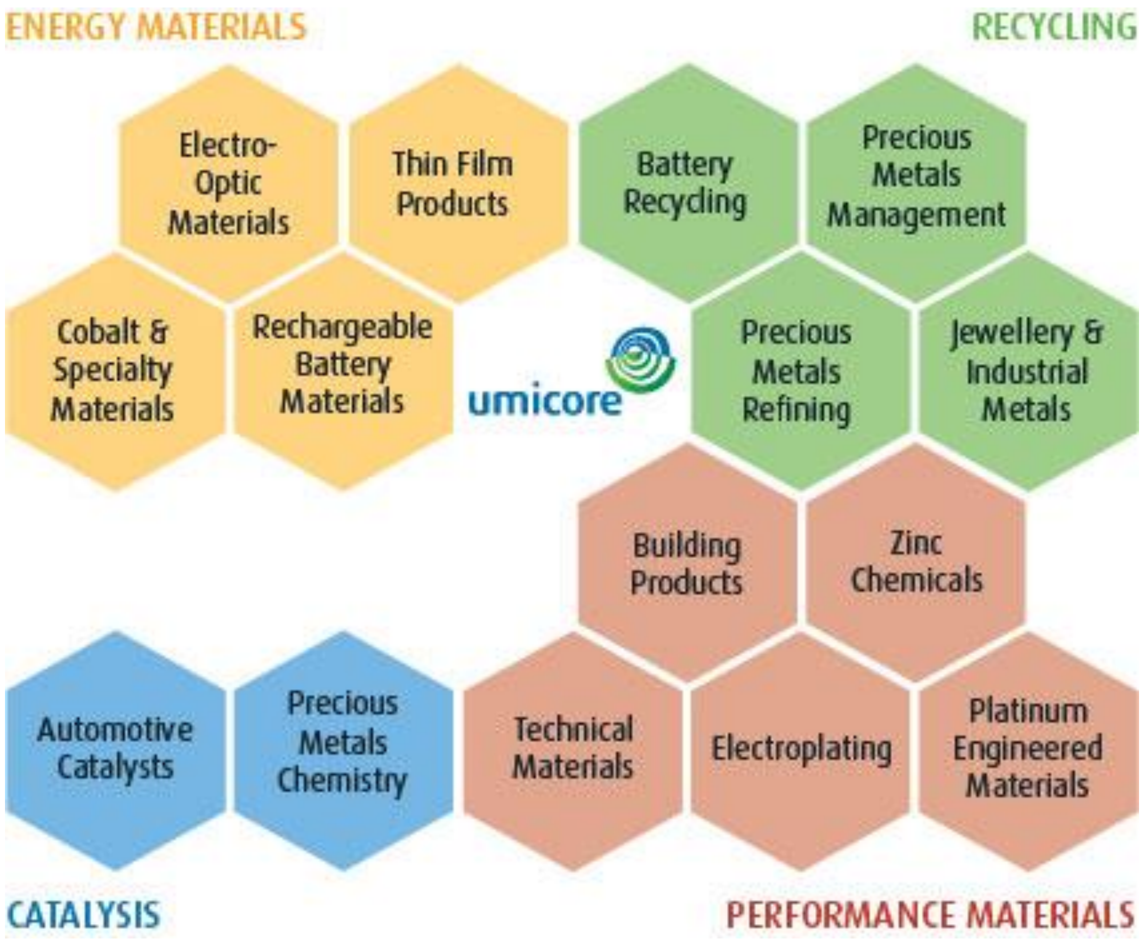
We provide catalysts for 1 out of 3 cars in the world as well as for trucks & non-road vehicles

Renewable energy

We supply key innovative materials for high-efficiency solar cells and other photovoltaic applications



Umicore's structure



Umicore and sustainability

- On January 23rd 2013, Umicore has been ranked as the most sustainable company in the "*Global 100 Most Sustainable Corporations in the World"* index.
- The index, based on many variables, is published annually since 2005 by Corporate Knights, an independent media and investment research company based in Toronto, Canada.

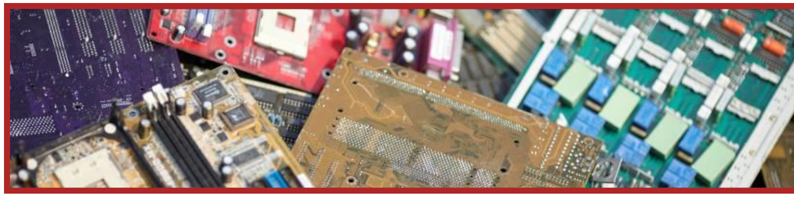
Exploring Umicore Precious Metals Refining

Excellence in recycling

UPMR: the leading precious metals recycler

- unique & innovative technology
- excellent services to an international customer basis
- wide range of complex precious metals bearing materials
- efficient recovery of 17 different metals
- applying world class environmental standards

Our core business



Raw materials supply

Sampling & Assaying

Smelting & Refining

Metals sales

Types of raw materials

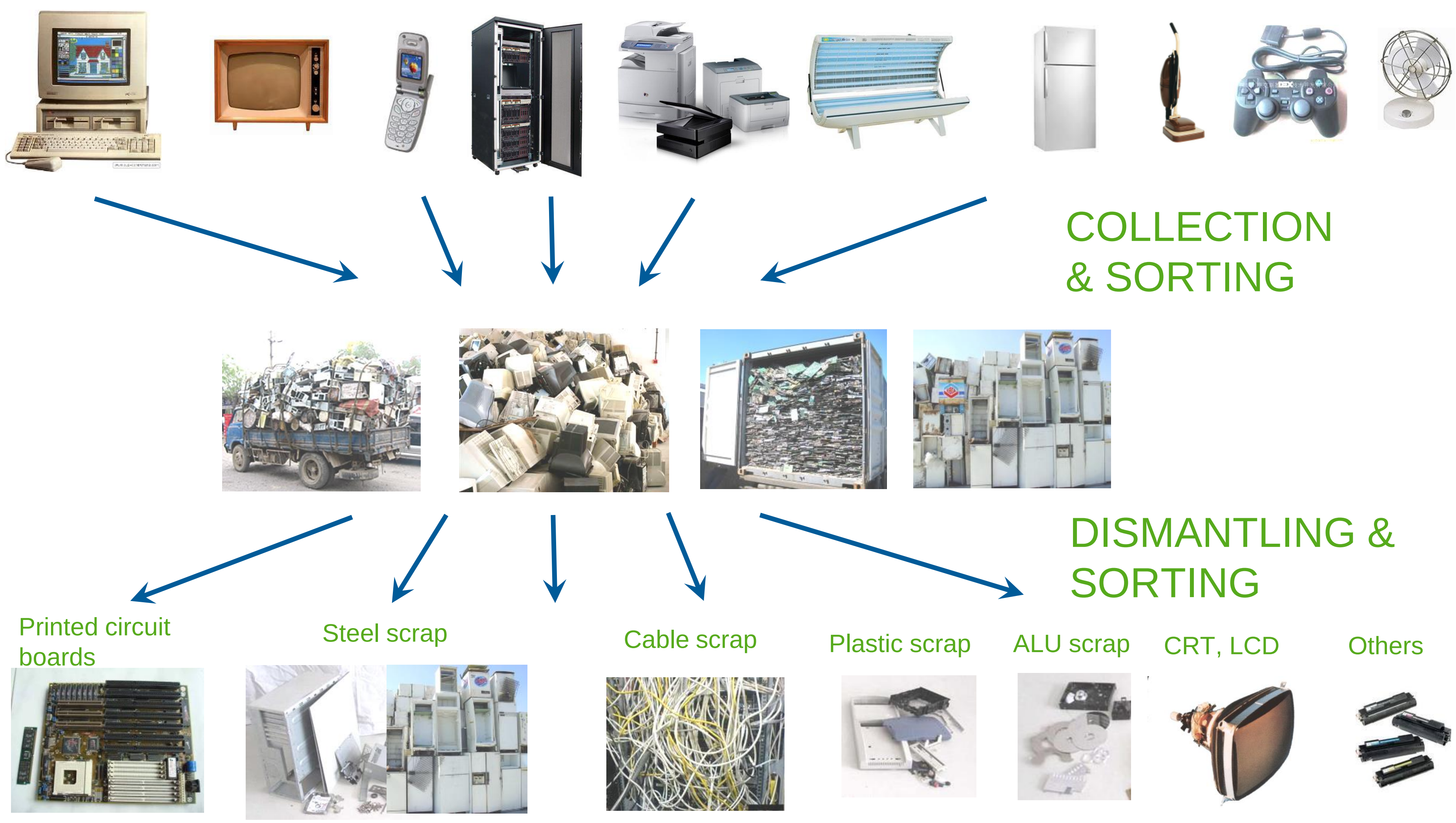
By-products	***Recyclable products***			***Others***
By-products from non-ferrous industry	**Spent Industrial Catalysts**	**Electronic Scrap**	**Spent Automotive Catalysts**	**Precious metal bearing raw materials**
				
e.g. drosses from **lead smelters, slimes** from **copper industry,…**	**Industrial catalysts** from **oil refining & petrochemical industry**	**e.g. printed circuit boards**	**end-of-life car catalysts**	**e.g. fuel cells, photographic residues**

E-scrap:

The Recycling Chain

E-waste, what are we talking about ?

E-waste: something to ‘deal’ with



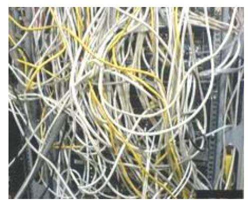
E-waste: something to 'deal' with

Printed circuit boards,

cell phones

Steel scrap

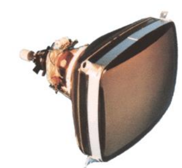
Cable scrap



Plastic scrap

ALU scrap

CRT, LCD



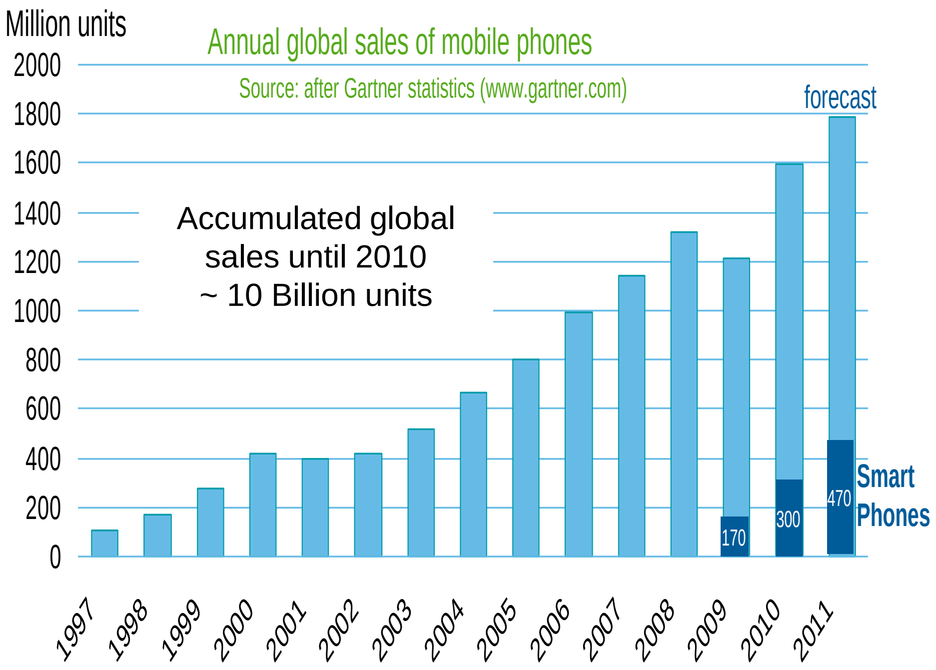
Others

LARGE DIVERSITY OF FRACTIONS

… THAT EACH REQUIRE TREATMENT BY SPECIALIZED COMPANIES

→ IT E-WASTE IS THE MOST HUNTED FOR

Booming product sales & increasing functionality drive demand for (technology) metals



www.teleco.com.br

1º Brazil → 262 million

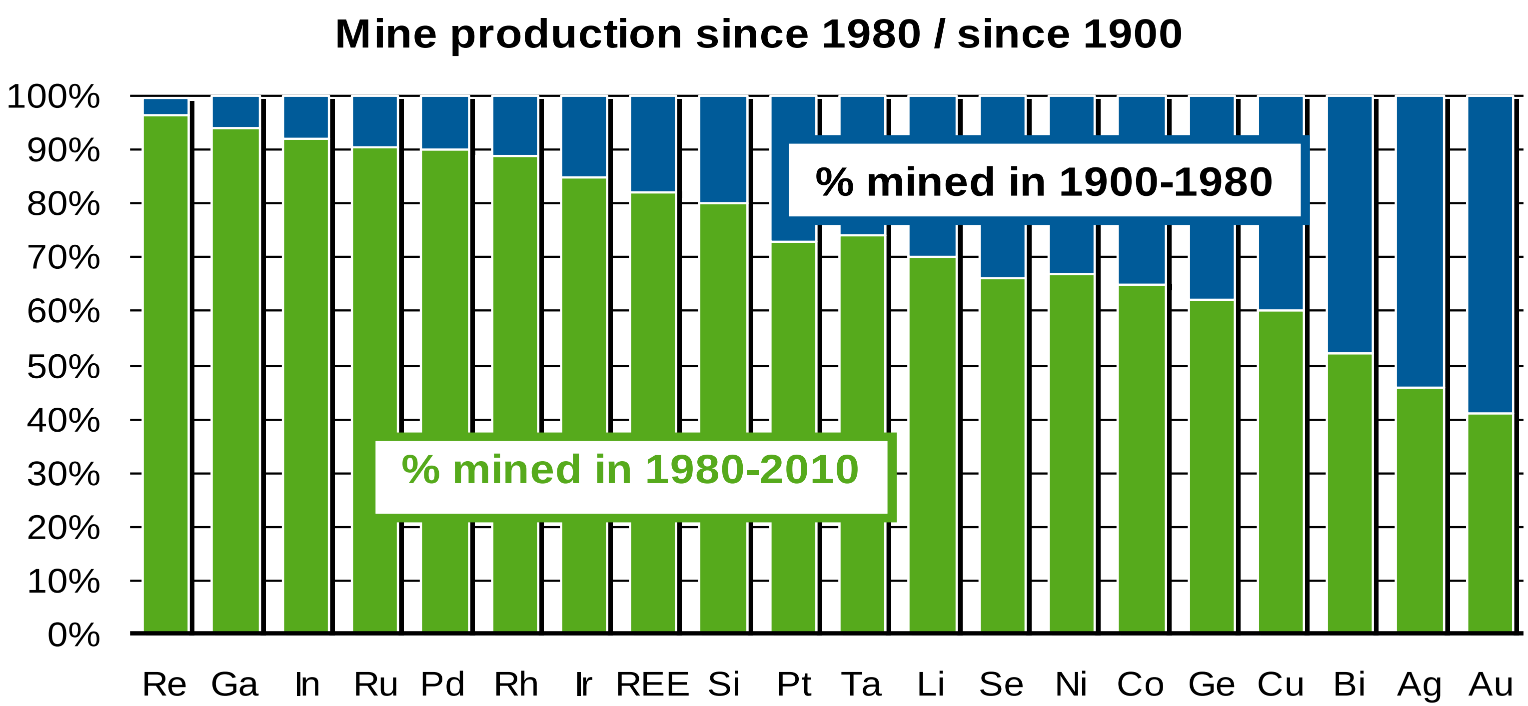
2º México → 101 million

3º Argentina → 59 million

4º Colombia → 49 million

5º Venezuela → 29 million

Recent boom in demand for most technology metals



REE = Rare Earth Elements

Low loadings per unit, but volume counts
Example: Metal use in electronics

Global sales, 2011

a) Mobile phones

1800 million units/ year

X125	mg	Ag	≈	225	t	Ag
X 25	mg	Au	≈	45	t	Au
X 4	mg	Pd	≈	7	t	Pd
X 9	g	Cu	≈	16,000	t	Cu

1800 million Li-Ion batteries

X 3.8	g	Co	≈	6800	t	Co

b) PCs & laptops

365 Million units/year

X1000	mg	Ag	≈	365	t	Ag
X 200	mg	Au	≈	73	t	Au
X 80	mg	Pd	≈	29	t	Pd
X~ 500	g	Cu	≈	183,000	t	Cu

~190 million Li-ion batteries

X 65	g	Co	≈	12 350	t	Co

a+b) Urban mine

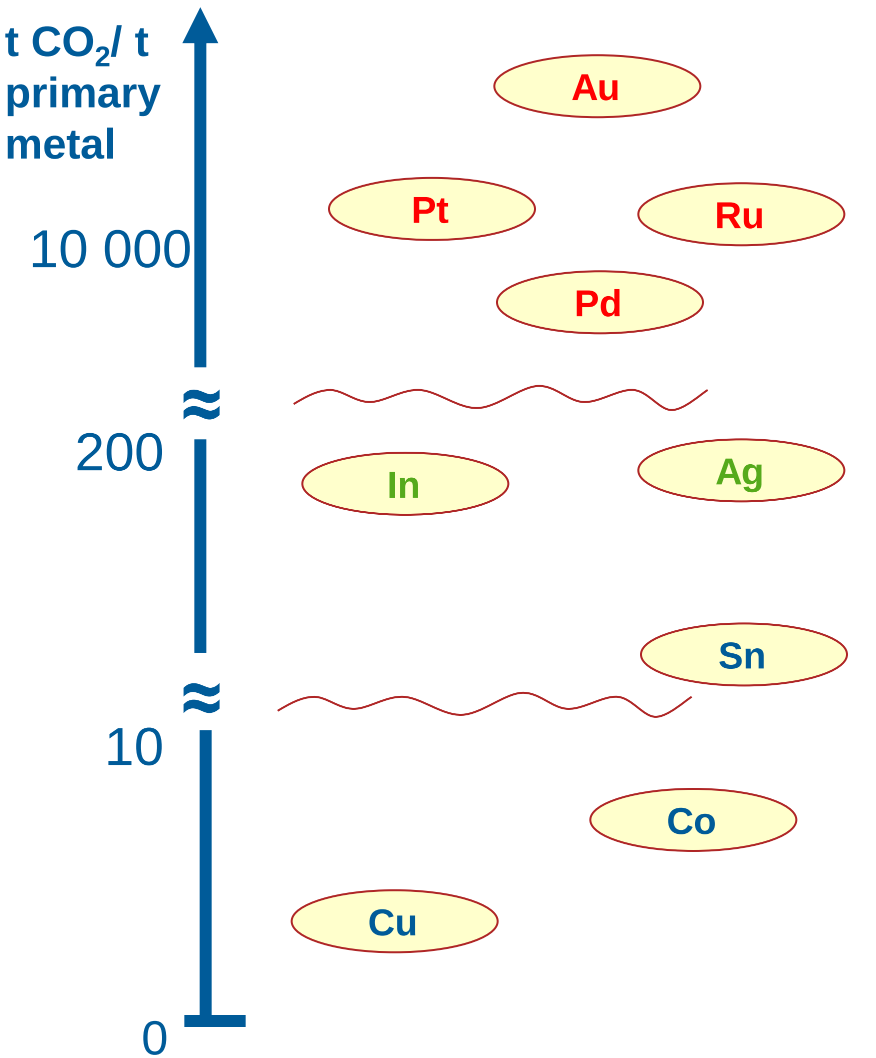
Mine production / share

Ag:	23 500	t/a	‣	3%
Au:	2 800	t/a	‣	4%
Pd:	230	t/a	‣	16%
Cu:	16	Mt/a	‣	1%
Co:	98,000	t/a	‣	20%

Tiny metal content per piece → Significant total demand

Other electronic devices add even more to these figures

and considering the CO_2 impact of primary metal production is huge …



source: ecoinvent 2.0, EMPA/ETH-Zürich, 2007

CO2 impact of secondary metal production is much lower for majority of metals

=> incentive to stimulate recycling

Example: 70.000 tons of metals produced by Umicore Hoboken in 2007 = **1 million tons of CO_2** savings vs primary metal production

UPMR → maximizing metal extraction from Urban mines

Primary mining

- ~ 5 g/t Au or PGM's in ore
- Low grade, high volume, fixed location

Urban mining

- 200 g/t Au, 80 g/t Pd & Cu, Sn, Sb, … in PC boards
- 2,000 g/t PGM in automotive catalysts
- High grade, million of units, globally spread

Reducing CO_2 emission significantly

Example:

Umicore Precious Metals Refining, Hoboken/Belgium (UPMR):

- recovered metals 2007*: 70,000 t
- total CO_2 impact of UPMR in 2007*: 0.27 Mt
- total CO_2 impact primary production**: 1.3 Mt

▸**CO_2 saving potential recycling*: 1.0 Mt**

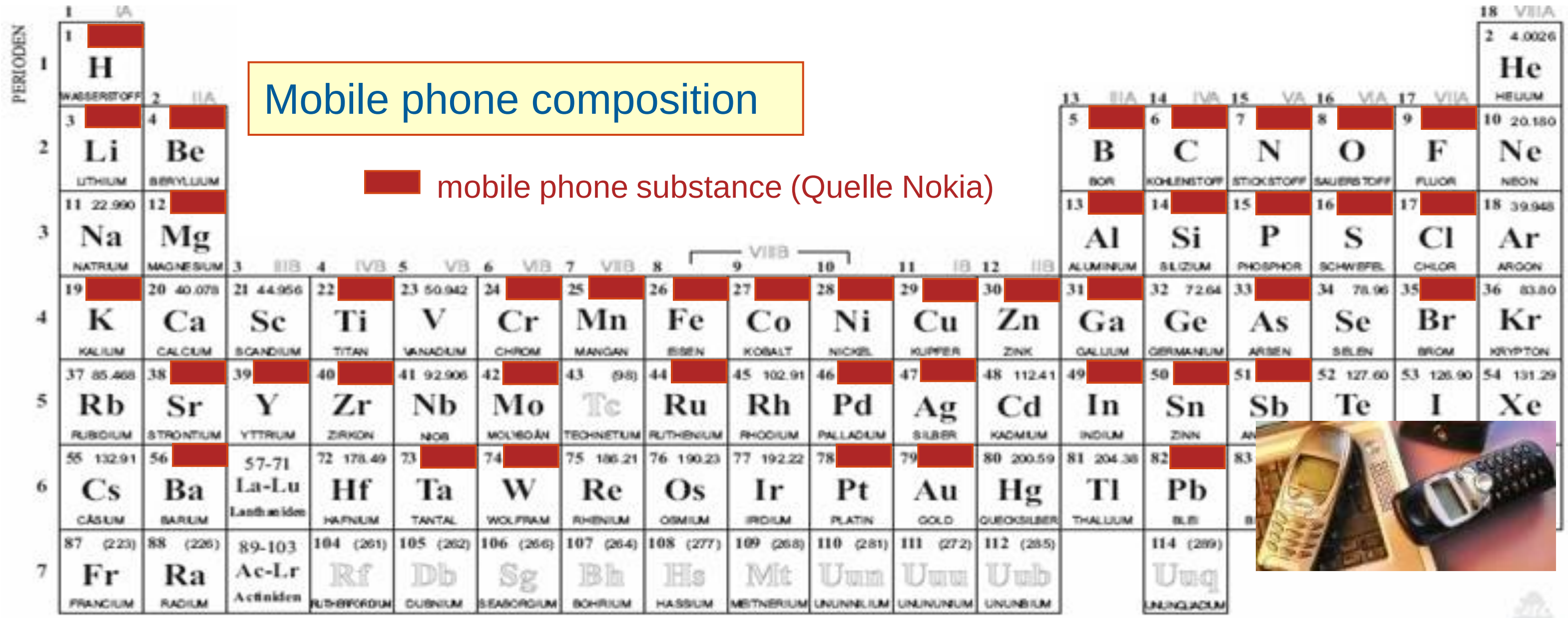
*from treatment of 300,000 t of recyclables & smelter by-products.
Output: 1000 t Ag, 30 t Au, 37 t PGM, 65 000 t Cu/Pb/Ni, 3500 t Sn/Se/Te/In/Sb/Bi/As

**if these metals would have come from primary production, calculated with ecoinvent 2.0:

the unavoidable "black box approach" of the UPMR calculation mixes the CO_2 impacts of very low grade materials (e.g. slags, flue dusts) with richer ones from recycling of consumer goods (e.g. circuit boards, catalysts)

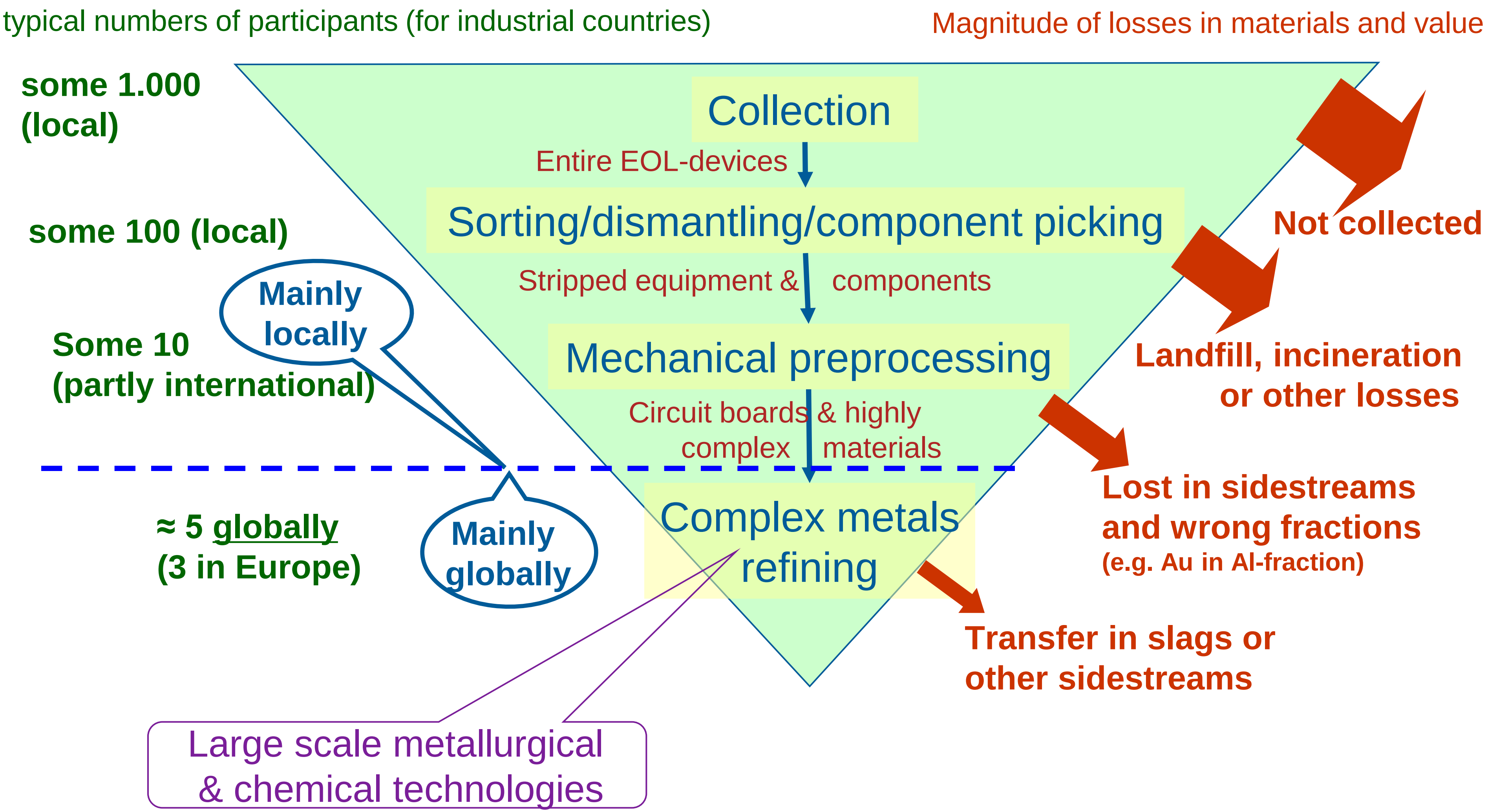
▸ for recycling of electronics the CO_2 benefit compared to mining is even higher!

Modern electronics make use of ~ 50% of elements from periodic table => a big consumer of natural resources



- Precious & special metals → „technology metals“, crucial for functionality
- Key components: circuit boards, batteries, LCD screens

E-waste: structure of recycling chain



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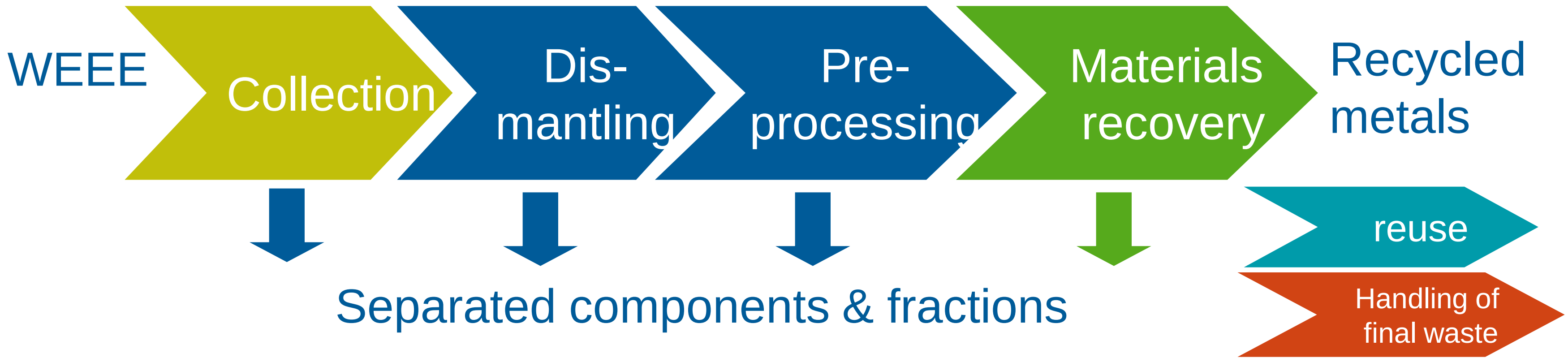
Recycling chain

Example: 10% x 90% x 80% x 95% = 7%

*effective recovery rate for e.g. Au, Cu etc. from EOL-streams



- ➢ Total efficiency is determined by the weakest step
  Consider the entire chain & its interdependencies

How does the recycling chain often look like in reality in some countries?

Or a gold recycling efficiency of: 95 % x 50 % x 25 % = 12 %*

backyard recycling ▸ “low tech”

- High losses, few metals recovered only dramatic environment & health impacts
- Typical for most Asian - African countries – LATIN AMERICAN COUNTRIES?

* Illustrative figures

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Another examples

Low collection




➩lack of legislation in some Latin American countries & new business models are required

"Deviation" of collected goods
➩ dubious exports ➩low quality "recycling"





➩"Tracing & Tracking", controls & enforcement, stakeholder responsibility, transparency

Still have some opportunities

	Number of cell phones Million units	Quantity for the next 2 years	10% decided to 'recycle' the device	Estimated quantity of Au to be recycled
	262.000.000 Million users	17.500 tons	1.750 tons	437 kg
	49.000.000 Million users	3.300 tons	330 tons	82,5 kg

15.000 cell phones = 1 ton of cell phones ≈ 250 grams of Au - Illustrative figures

Very important source of materials / metals (Au, Ag, Cu, Pd and others)
Pulverized in the market and challenge to collect, sort and recycle.

How should/could the recycling chain look like in some countries?

Or a gold recycling efficiency of: 95 % x 90 % x 95 % = 81 %*

What is needed to achieve this result?

- Maximum & organized collection, with adequate presorting of various types of WEEE
- Focused dismantling (=> training is needed !)
- Best available end-processing technology (=> best environmental performance often goes hand in hand with best recycling performance)
- Tracing & tracking, transparency, controls.

→ SYNERGIE CAN BE ACHIEVED BY RIGHT INTERNATIONAL PARTNERSHIP

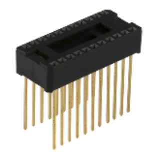
* Illustrative figures

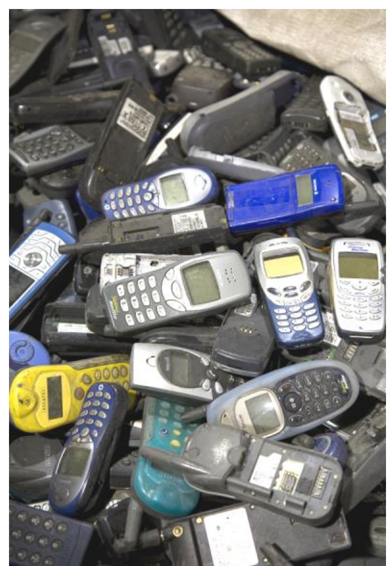
Umicore's e-scrap: complex & precious metals

UPMR is specialized in treating complex fractions with precious metals

Typically

- printed circuit boards
- cell phone handsets
- IT components (chips, CPU, processors)
- metallic pins
- IT connectors





Challenges for Emerging Regions

Informal sector: a useful network

- collection experience: existing broad network with door-to-door service, but sometimes informal
- recycling experience: out of livelihood, broad experience in sorting, dismantling & repair
- Good work environment requires moderate investment (training, infrastructure, fair wage.....)


Challenges for Emerging Regions

Informal sector: a useful network

Weaknesses

- Back-yard 'refining' = artisanal burning & leaching:
- fast access to metals,
- low yield recovery (Au < 20% recovery)
- no EHS measurements, no awareness

- Absence of proper 'transparent' end-refining technology (?)

Implementing recycling technologies

Collection / manual sorting & dismantling

- ❑ **HIGH PRIORITY**
- ❑ **Low investment cost**
- ❑ **Use the strength of available workforce**
  - ✓ Involve informal sector & create skilled labour

Mechanical pre-processing (shredding/seperation)

- ❑ **Useful for high volumes of e-waste without or with low precious metal content (small domestic appliances, white goods, engines, …)**
- ❑ **Moderate investment cost**

Smelting/refining (resource recovery)

- ❑ **Only useful if formal collection is organized**
- ❑ **High investment cost**
- ❑ **Big scale operations required to achieve high recovery yield & to make use of economy of scale**

Recommendations

- Assure <u>organized collection first</u> before thinking of high tech refining technology

- Proper collection by <u>actively involving the existing unofficial sector</u> instead of excluding them. Make use of the available strengths among the informal recyclers

- Create/implement <u>legislative framework</u> that <u>promotes/facilitates formal collection & recycling</u> and that discourages/hinders informal recycling (and not the other way around)

- If no collection → no recycling

34

Recommendations

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- **<u>Maximize</u> the use of <u>manual dismantling</u> and minimize mechanical pre-processing as far as the *precious metals bearing e-waste* is concerned**

- **The more complex/interlinked the material, the less selective are mechanical separation processes and the higher are <u>losses of precious metals</u> by co-segregation**

35

Recommendations

- **End-processing (physical materials recovery) is crucial for final value generation & toxic control.**

- **Recycling trace elements from complex products needs "high-tech", large scale processes which cannot be replicated in any country.**

- **Use *synergy* of locally available workforce for dismantling/pre-processing and internationally available technology for materials recovery: economy of scale & international division of labour**

36

Conclusions

- Legislation extremely important;
- Motivate collection/define targets;
- More environmental awareness;
- More transparency/control of flows;
- Sector Informal to FORMAL;
- Reuse as part of the process;
- Ensure quality recycling (complex materials);
- Recycling needs a chain, not a single process;
- **If no collection → no recycling**

Thanks for your attention

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