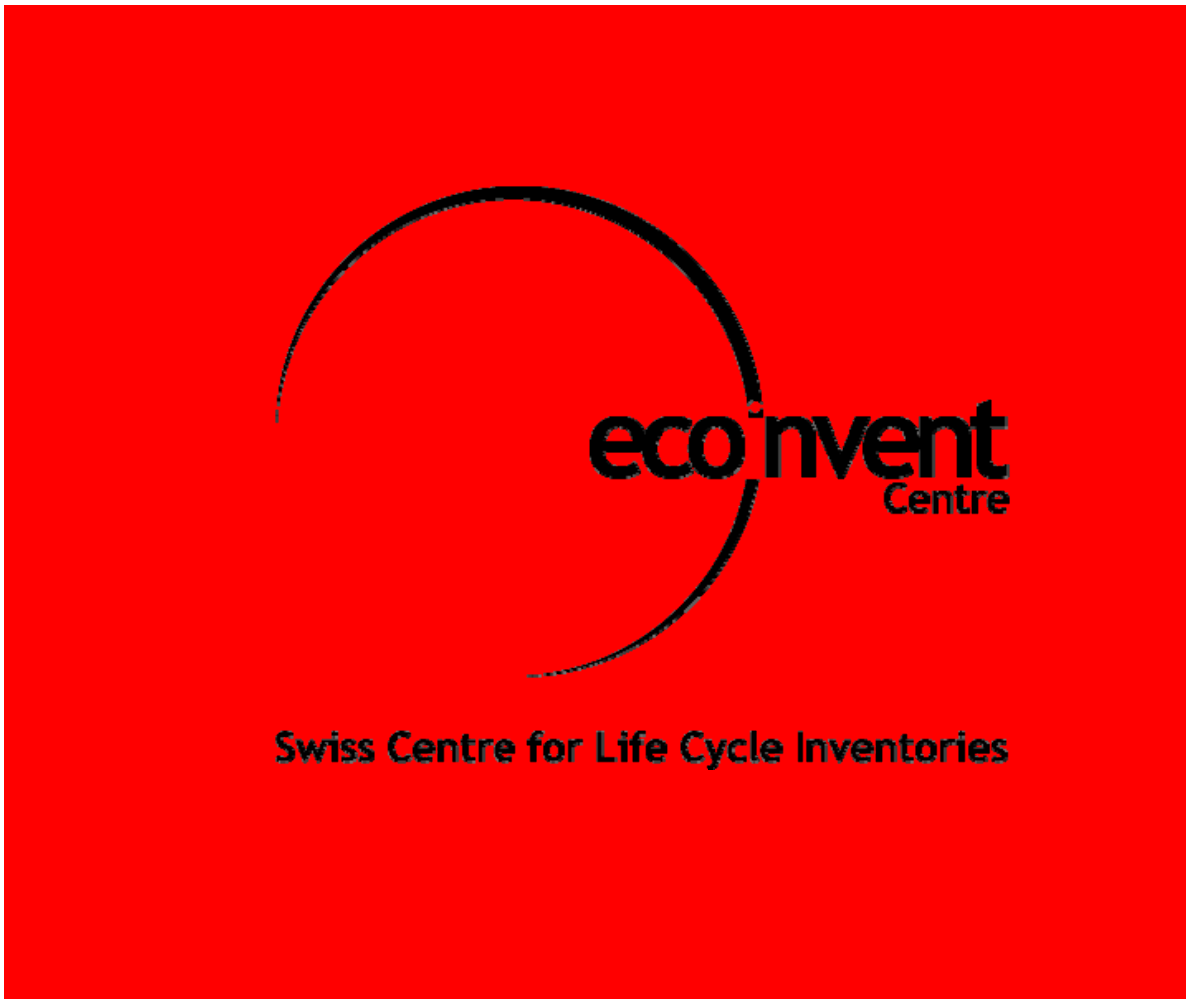

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2nd International ecoinvent Meeting
Lausanne, March 14, 2008

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ecoinvent data v2.0
Metals (for ICT): Introduction

Hans-Joerg Althaus, Empa

Session overview

- Introduction
  Hans-Joerg Althaus, Empa
- Modelling Principles and Results
  Mischa Classen, Empa
- Gold and Silver
  Sybille Büsser, ESU-services (→ see separate file !)
- Discussion

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Metals in ecoinvent data v2.0

- 204 Datasets, 110 new ones
- 92 “end-user” Datasets, 32 new ones
- Existing Datasets partly updated and refined

  → some relevant changes in LCIA results

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Metals in ecoinvent data v2.0

- New data mainly for metals used for ICT
- Most metals produced from coupled resources
  → complex modelling necessary
- Many metals produced from very low concentrated ores
  → relevant influence of allocation procedure

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Presentation: Hans-Joerg Althaus

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metals:

Modelling Principles and Results

Mischa Classen, Empa Dübendorf

Overview

- Objectives and approach for v2.0
- Implementation of LCI-extension
  - Accounting for resource use
  - Co-product allocation
  - Correction for mass balance
- Conclusions
- Overview of valuation results
- Changes of selected indicators with v2.0

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Metals in ICT

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- Metals play a vital role in consumer products
- Ever more complex materials in increasing pace developed
- Small amounts of expensive materials used
- Challenge of covering the most relevant metals with LCI

Metals in ICT - Uses

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- Metals are used in EEE as
  - Bonds and Contacts: Silver, Gold, Copper, Platinum Group Metals
  - Semiconductors: Silicium, Cadmium Telluride (CdTe), Gallium Arsenide (GaAs)
  - Conductive Layers: Indium Tin Oxide (ITO)
  - Capacitors: Tantalum Powder

Metals in ICT - Sources

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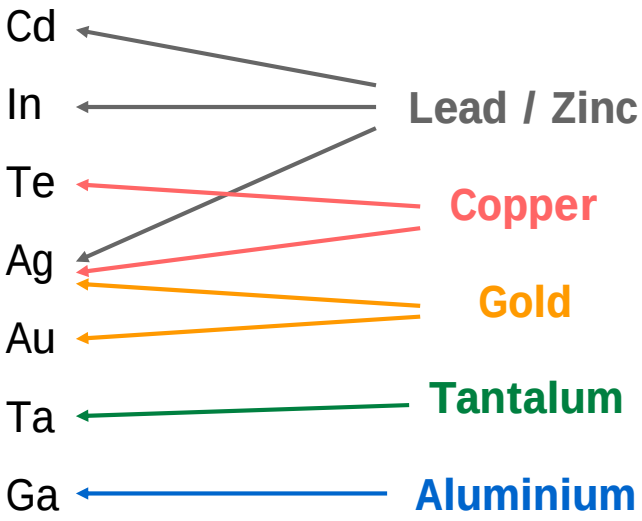
- Sources of the identified new metals



Metals in ICT - Web of Metals

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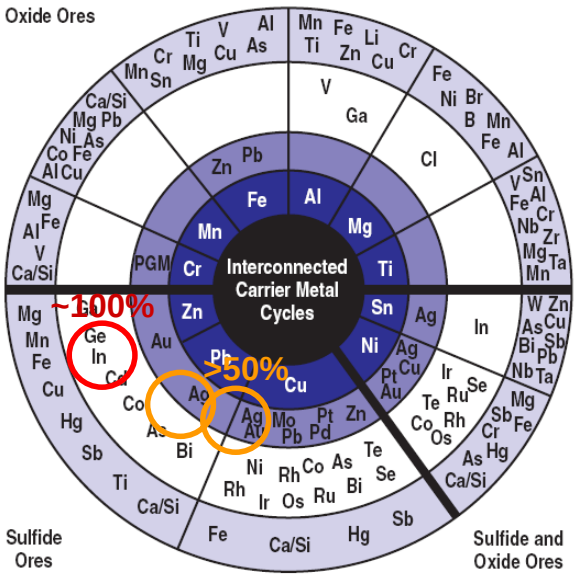
- Orebodies contain characteristic mix of metals
- Apart from mainprocucts:
  - Co-products
  - By-products
  - Inpurities
- Guidance for LCI modelling:
  - Which coproducts?
  - Nature of allocation



Wheel of metals (Reuter, JOM 2004)

Modelling Approach I

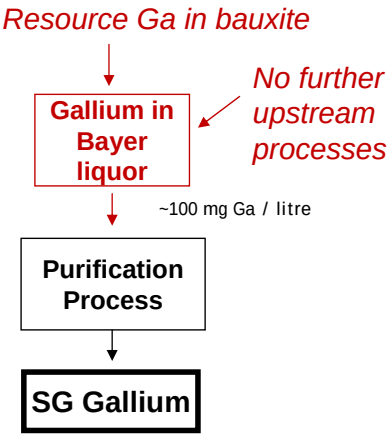
Gallium: Co-Product of Aluminium extraction

Low economic interest for Alu industry, price determined by purification

- Allocation of upstream burden based on economic criteria → "zero-allocation"
- Allocation of resource based on physical criteria

Treat Resource like Technosphere process

Aluminium Inventory not affected



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Modelling Approach II

Tellurium: Co-Product of Copper-extraction, jointly with Silver

Some economic interest for Copper industry (namely Silver)

- Allocation of upstream burden based on economic criteria
  → Proceeds of the final commodities Tellurium and Silver
- Allocation of resource based on mass

Approximate upstream processes with existing LCI

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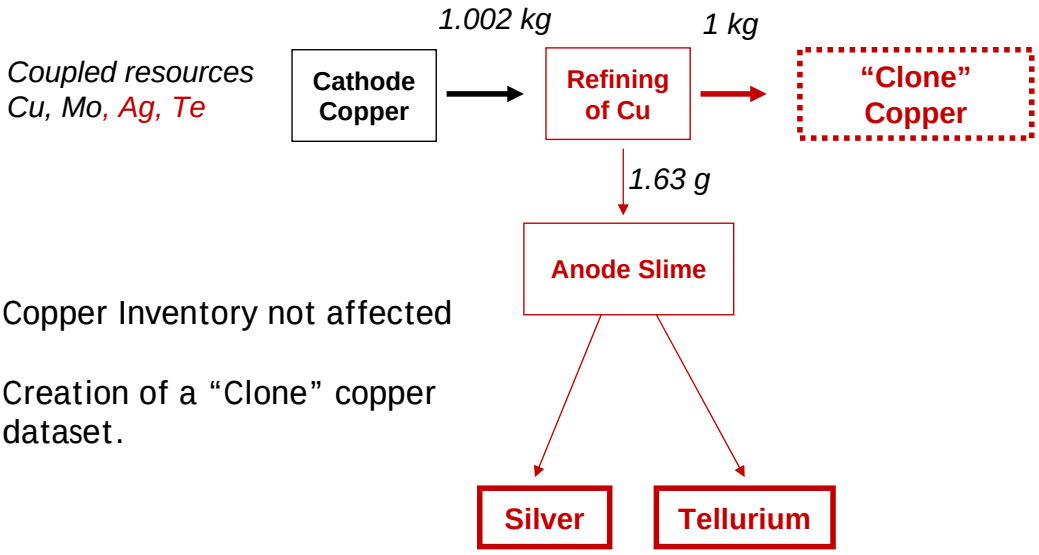
Modelling Approach II

- Aproximate upstream processes with existing LCI



Copper Inventory not affected

Creation of a "Clone" copper dataset.

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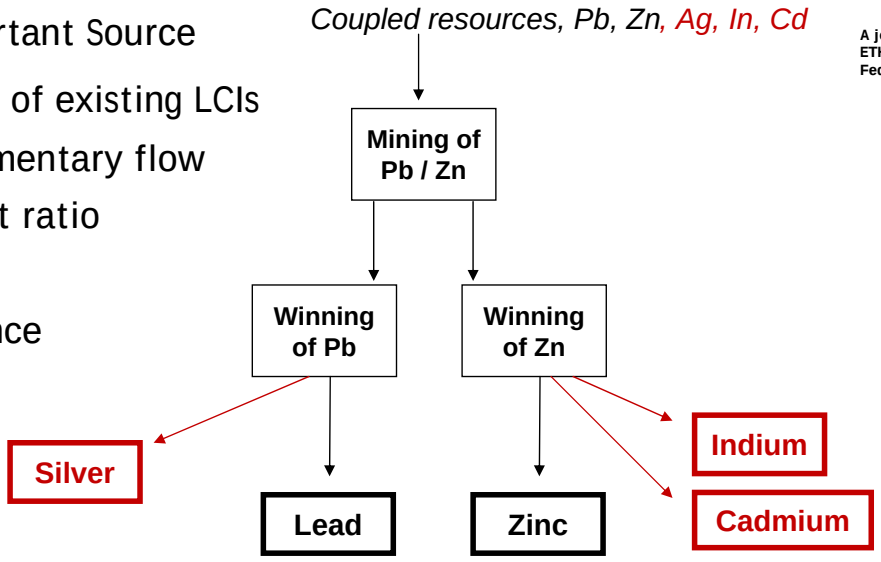
Modelling Approach III

Silver, Indium and Cadmium

Pb/Zn = important Source

- Full extension of existing LCIs
  - Adapt elementary flow
  - Co-product ratio
  - Allocation
  - Mass balance correction



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Designation of Resource flow

Silver, 0.007% in sulfide, Pb 3.0%, Zn 5.3%, Ag 0.004%, Cd 0.18 %, In 0.003 %, in crude ore, in ground

- Based on ore concentrations,
  - But: no distinguishable ore type for co-product metals
- Harmonised with LCI model
  - Production ratio of carrier metal and co-product
  - Extraction yield
  - Processing yields
- Concentrations have to rely on back-calculations
  - global production of carrier metal (e.g. Lead) and
  - co-product metal (e.g. Silver)

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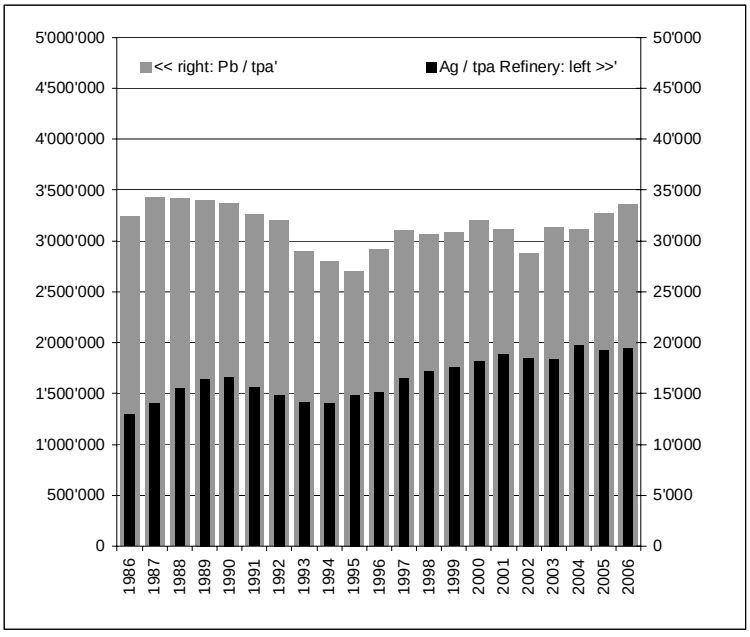
Production Ratio of Co-product

- Scaled to world wide production, eg. Silver from Lead cycle



- 21% Ag from secondary
- 31 % Ag from lead

→ 24% of 20'000 tpa Ag

→ 0.142% of Pb production

Per kg Lead

... 1.42 g refined Silver, or

... 8.1 g Parkes Crust @ 18% Ag

... 1.86 kg ore concentrate @ 0.08% Ag

... 21.5 kg **minerals in ore @ 0.007% Ag**

... 36.2 kg crude ore @ 0.0043% Ag

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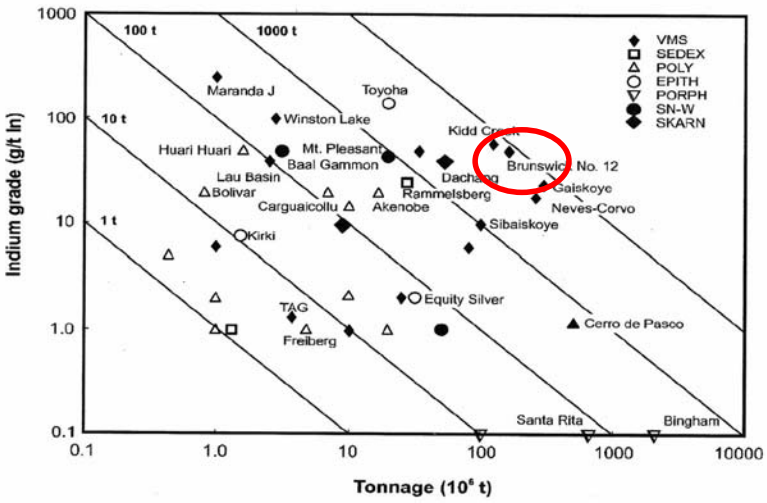
Production Ratio of Co-product

- Top down vs. bottom up, eg. Indium from Zinc cycle



Schwarz-Schampera & Herzig (2002)

Discrepancy:

Avg. grade: 50 ppm

Back-calculated: 19 ppm

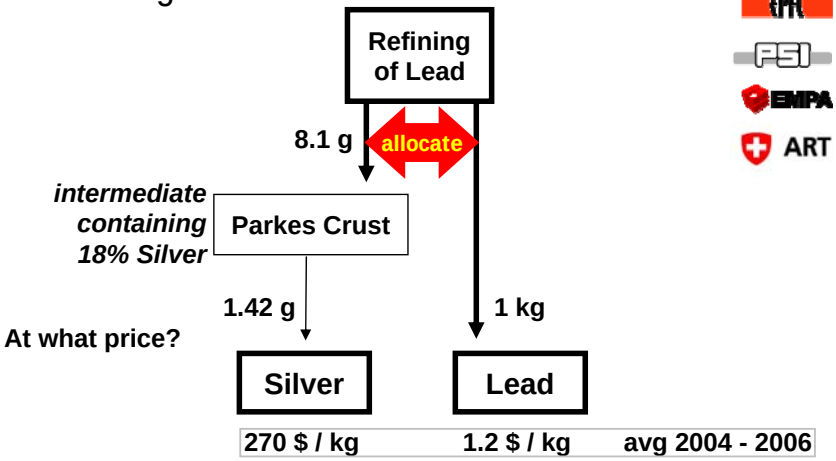
50ppm would mean over the double global output than actually reported

Assumption: not all of the In in the extracted ore is refined.

- 40% of the In-values are dumped with the gangue.

Allocation procedure

- By revenue
  - Cd considered inpurity: zero-allocation
  - Split refined commodity vs. Intermediate
    - e.g. Silver from Lead refining



Allocation procedure

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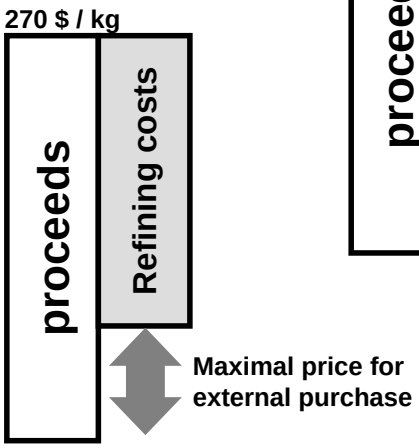
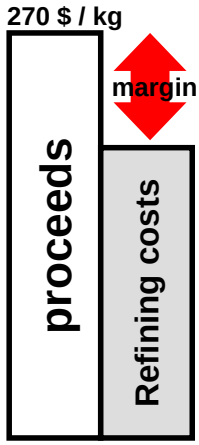
- Reasoning
  - Intermediate (Parkes Crust) „for free“
  - Targeted profit at company level: 10%
- What would be the max. price for external purchase?
  = opportunity cost

→ Same as margin,
→ 10 % of proceeds by refined commodities, disregarding subsequent possible process losses





Allocation procedure

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- Calculation scheme
  - All metal values in intermediate accounted for
  - Total process yield considered

Lead / Silver bearing concentrate	Process Yield	lead concentrate	parkes process crust	lead	Value in $ / kg
composition		input	output	output	
Pb	98.0%	55%	39%	100%	1.15
Ag	97.4%	0.08%	18%	0%	27
Amount	kg	1.86	0.0081	1	
Value contained in $	$		0.04	1.15	
Allocation by Value			3%	97%	

Correct Mass Balance of Resource

- Hybrid allocation scheme:
  - Economic for process-emissions and upstream
  - Physical where mass balance required (resource)

correction from economic to per mass			according to economic allocation	
Resources demand in the feed			Lead	Parkes process crust
Concentrate	kg	1.86	97%	3%
Pb	kg	1.074	1.039	0.0354
Ag	kg	0.00157	0.00152	0.000052
Resources attributed in by-product			according to per mass allocation	
Pb			1.074	
Ag				0.00157
Resource exchange flow			difference to be corrected	
Pb			0.03536	-0.03536
Ag			-0.001515	0.001515

Correct Mass Balance of Resource

- Representation in ecoinvent

848	hard coal, burned in industrial furnace 1-10MW	RER	0	6.9718	MJ	lognormal	1.2515
oil/heating systems							
1589	heavy fuel oil, burned in industrial furnace 1MW, non-modulating	RER	0	0.28422	MJ	lognormal	1.2515
metals/extraction							
1100	iron ore, 65% Fe, at beneficiation	GLO	0	0.063572	kg	lognormal	1.2515
1104	lead concentrate, at beneficiation	GLO	0	1.8553	kg	lognormal	1.3297
10965	resource correction, PbZn, silver, positive	GLO	0	0.001515	kg	lognormal	1
10966	resource correction, PbZn, silver, negative	GLO	0	0.001515	kg	lognormal	1
10967	resource correction, PbZn, lead, positive	GLO	0	0.03536	kg	lognormal	1
10968	resource correction, PbZn, lead, negative	GLO	0	0.03536	kg	lognormal	1
construction materials/others							
529	limestone, milled, packed, at plant	CH	0	0.66875	kg	lognormal	1.2515
natural gas/heating systems							
	natural gas, burned in industrial furnace	RER	0	0.57721	MJ	lognormal	1.2515

Conclusion & Outlook

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- Coupled metal resources: integrated LCI model needed
  - Interconnection of primary, by-product and secondary production!
  - Many choices for allocation and system-model
    → together with stakeholder?
  - Aim: Harmonisation within whole metal sector

Results - Overview

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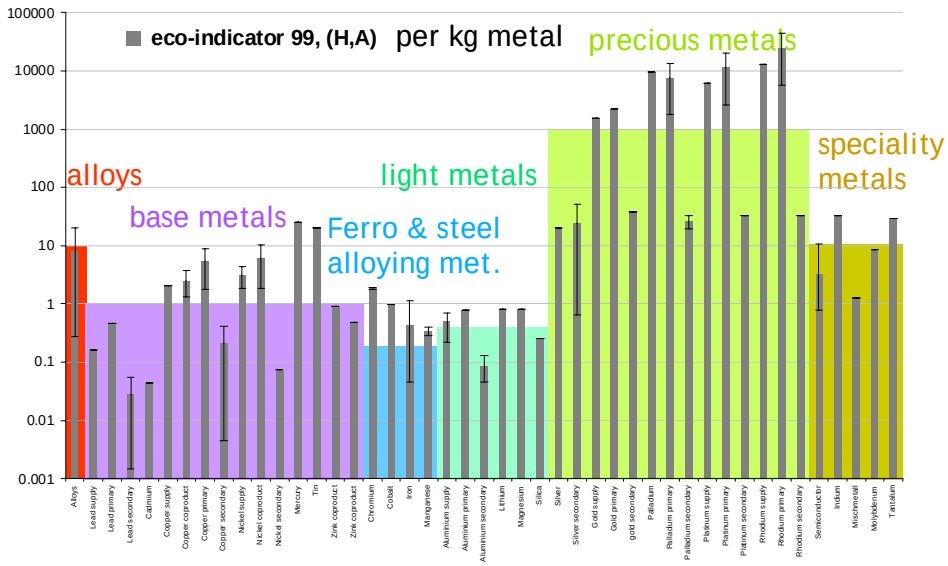
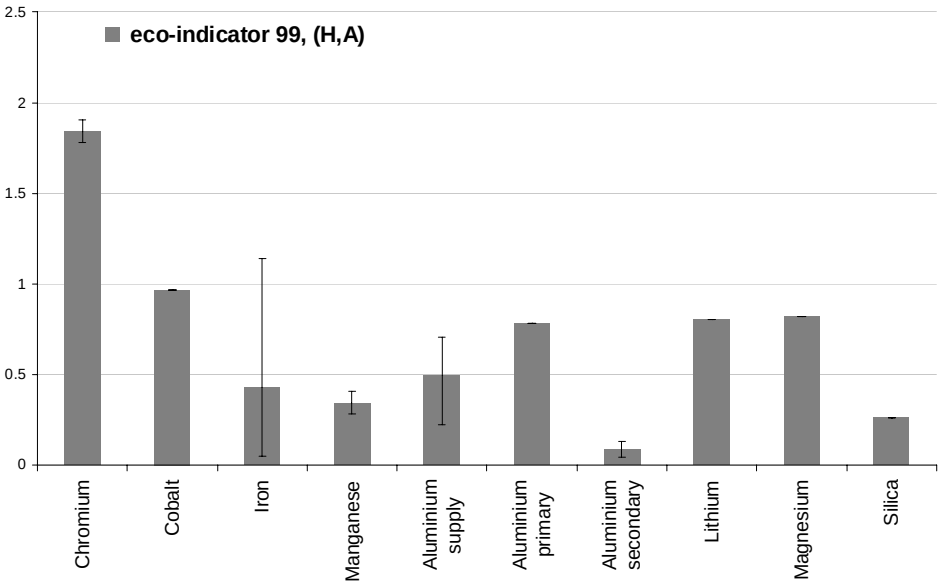
- Indicator results range over five orders of magnitude



Results - Light and ferrous Metals



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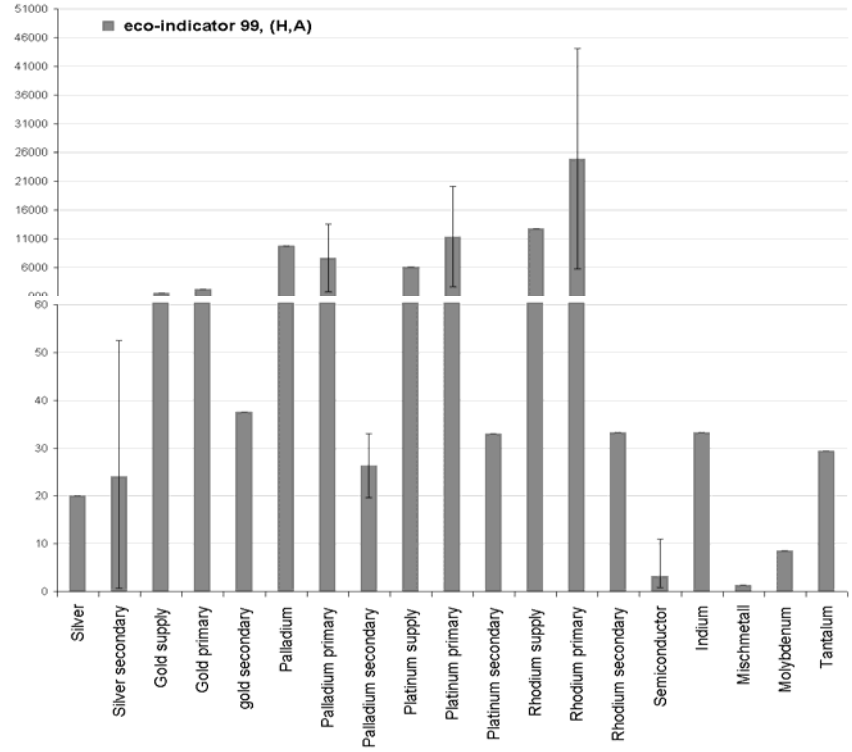
Results - Precious and speciality M.



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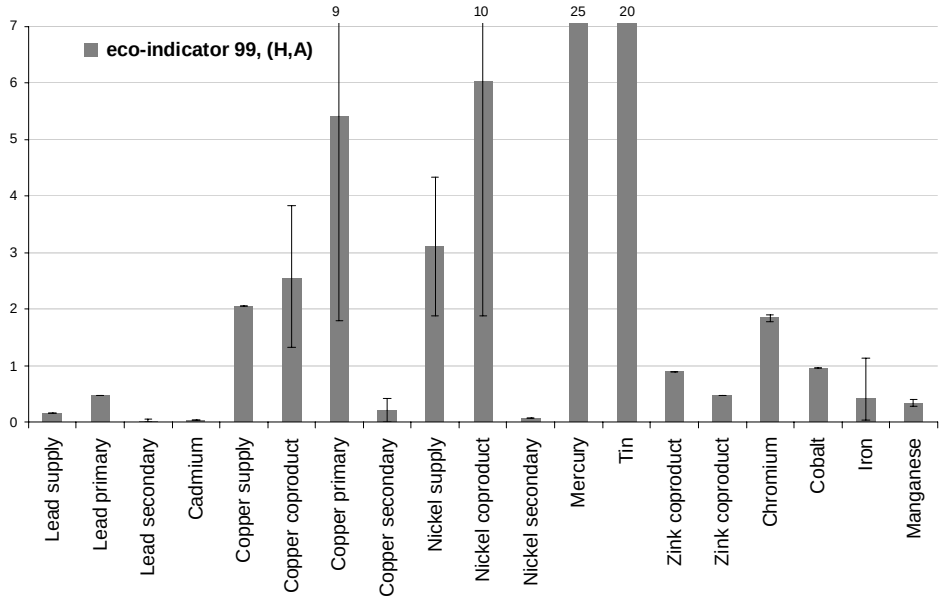
Results - Base Metals



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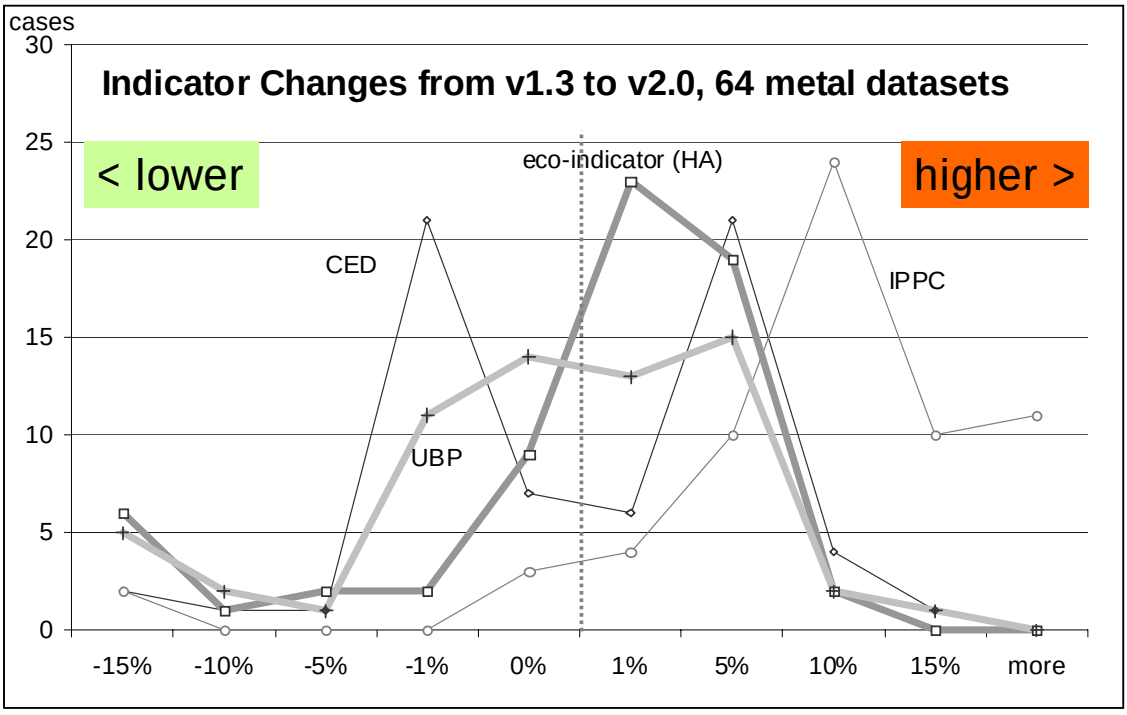
Changes with v2.0



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Changes with v2.0

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- Due to
  - Changes in background data
  - Correction of errors
- Generally IPCC higher (5-10 %)
- Specifically
  - **SXEW Copper** plus 10-30%: changed background data?
  - **Lead** minus 30-80%: introduction of secondary metal
  - **EAF steel**: minus 15-25%
  - **BOF steel**:
    - minus 25% Tox (UBP, eco-indicator),
    - plus 20% energy related (IPCC, CED)

Thank you!

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