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Managing Abiotic Resources

How Mine Investment and Production Works

55th LCA Discussion Forum
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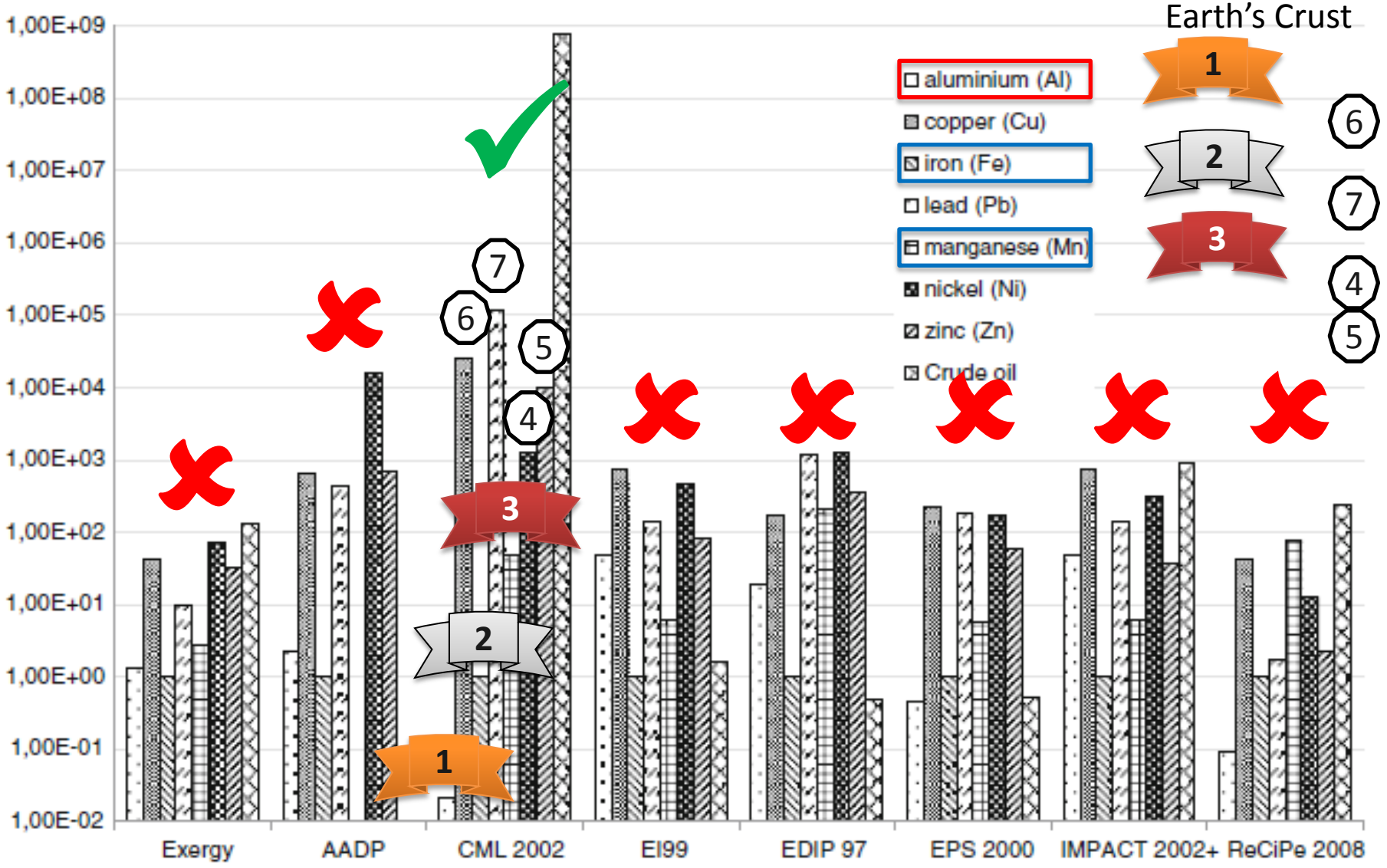
Lack of Alignment:

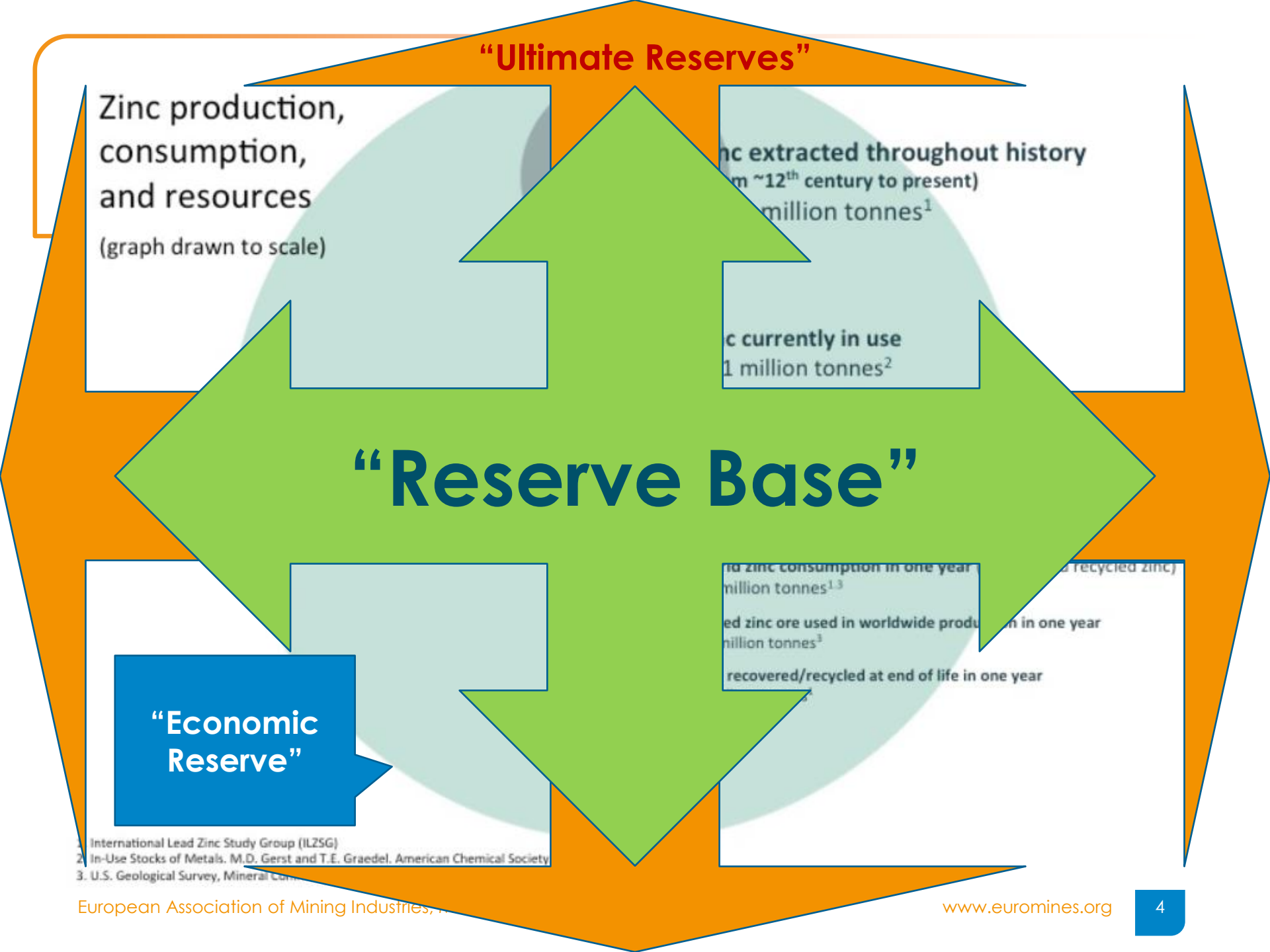
Order of abundance in Earth's Crust



Klinglmair M, Sala S, Brandão M (2013) Assessing resource depletion in LCA: a review of methods and methodological issues. Int J Life Cycle Assess 19:580-592 DOI 10.1007/s11367-013-0650-9

What are Reserves?

LCA Practitioners' Definition	Mining Industry's (CRIRSCO) Definition
"Ultimate Reserves"	(not reported)
"Reserve Base"	Defined + Potential Resources (incl. min. resources & min. reserves)
"Economic Reserve"	"Mineral Resources" (including mineral reserves)
(not mentioned)	"Mineral Reserves"


"Ultimate Reserves"
Zinc production, consumption, and resources
(graph drawn to scale)
nc extracted throughout history
m ~12th century to present)
million tonnes1
c currently in use
1 million tonnes2
"Reserve Base"
d zinc consumption in one year
million tonnes1,3
ed zinc ore used in worldwide produ in one year
illion tonnes3
recovered/recycled at end of life in one year
"Economic Reserve"
1. International Lead Zinc Study Group (ILZSG)
2. In-Use Stocks of Metals. M.D. Gerst and T.E. Graedel. American Chemical Society
3. U.S. Geological Survey, Mineral

What are Ore Grades?

Ore Grade	Cut-off Grade	Run-of-Mine Grade
% in the rock *in-situ*	**% required for profitable extraction**	**% in the ore sent for processing**
observable environmental fact	site-specific management standard	observable performance metric
Natural spatial variation	Temporal variation due to changing costs & prices	Temporal variation due to Δore grade + Δcut-off grade + Δperformance

≡ How do they relate to environmental inputs/outputs?

- = Energy, water, oxygen, waste, contaminants → Influence other AoPs
- = Natural resource stocks → They simply don't

Clearly Differentiate the Concerns and available Tools

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≡ **Resource depletion**: that the global amount of a specific resource could be exhausted

= **This is a long-term <u>environmental</u> concern** → **LCA/PEF**

(Guinée et al. using ultimate reserves)

≡ **Resource scarcity**: that supply of a specific resource could be insufficient to meet demand

= **This is a medium-term <u>societal</u> concern** → **CRIRSCO**

≡ **Raw-Material Criticality**: that a scarce resource is also important (e.g., economically, or for defence)

= **This is an immediate <u>economic</u> concern** → **EU Method**

Guinée et al. using ultimate resource data is still the most appropriate for assessing the identified environmental concern.

In case of any questions please contact:

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What are Resources?

Mineral Resource - A Mineral Resource is a concentration or occurrence of solid material of economic interest in or on the Earth's crust in such form, grade or quality and quantity that there are ***reasonable prospects for eventual economic extraction***. The location, quantity, grade or quality, continuity and other geological characteristics of a Mineral Resource are ***known, estimated or interpreted from specific geological evidence and knowledge***, including sampling (CRIRSCO, 2013).

What are Reserves?

- **Mineral Reserve** - A Mineral Reserve is ***the economically mineable part*** of a Measured and/or Indicated Mineral Resource. It includes diluting materials and allowances for losses, which may occur when the material is mined or extracted and is ***defined by studies at Pre-Feasibility or Feasibility level*** as appropriate that include application of Modifying Factors. ***Such studies demonstrate that, at the time of reporting, extraction could reasonably be justified***. (CRIRSCO, 2013).

How to assess extraction from the natural environment?

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≡ Resources as a separate safeguard subject:

Environmentally Relevant?	Yes
Environmental mechanism?	Muddled !
Current methods?	Useable for other questions (e.g., societal)
Alignment?	Between abiotics – Mostly No Between biotic & abiotic - No
The Future?	Right tool box for the concerns (LCA cannot do it alone)

Stock or Fund Resources?

- Renewable resources are consumable / degradable and *relatively* limited
  - Assumed to be fund resources, but may be completely reliant on land or top-soil – and in that sense relatively limited in stock
- Non-renewable resources are often elemental / persistent and *relatively* unlimited
  - Assumed to be stock resources, but may behave more as fund resources (e.g., defined "mineral resources" with in & out flows)
- Over time, the prospecting and mining industries consistently add more minerals to proven reserves than they extract.

$$140Mt\ Zn_{1994} + 11yrs\ exploration\ - 11yrs\ extraction = 220Mt\ Zn_{2005}$$

What about Resource Efficiency?

- Resource
  - Biotic, Abiotic, Land, Air, Water
  - Different issues, different risks
  - Different environmental mechanisms
  - Different solutions required

- Efficiency
  - Optimisation
  - Mostly Some Benefits v Different Costs
  - Cross-media effects; burden shifting
  - Resource Efficiency ≠ 1 single Area of Protection
  - Resource Efficiency ≠ LCA results only (other tools are needed)