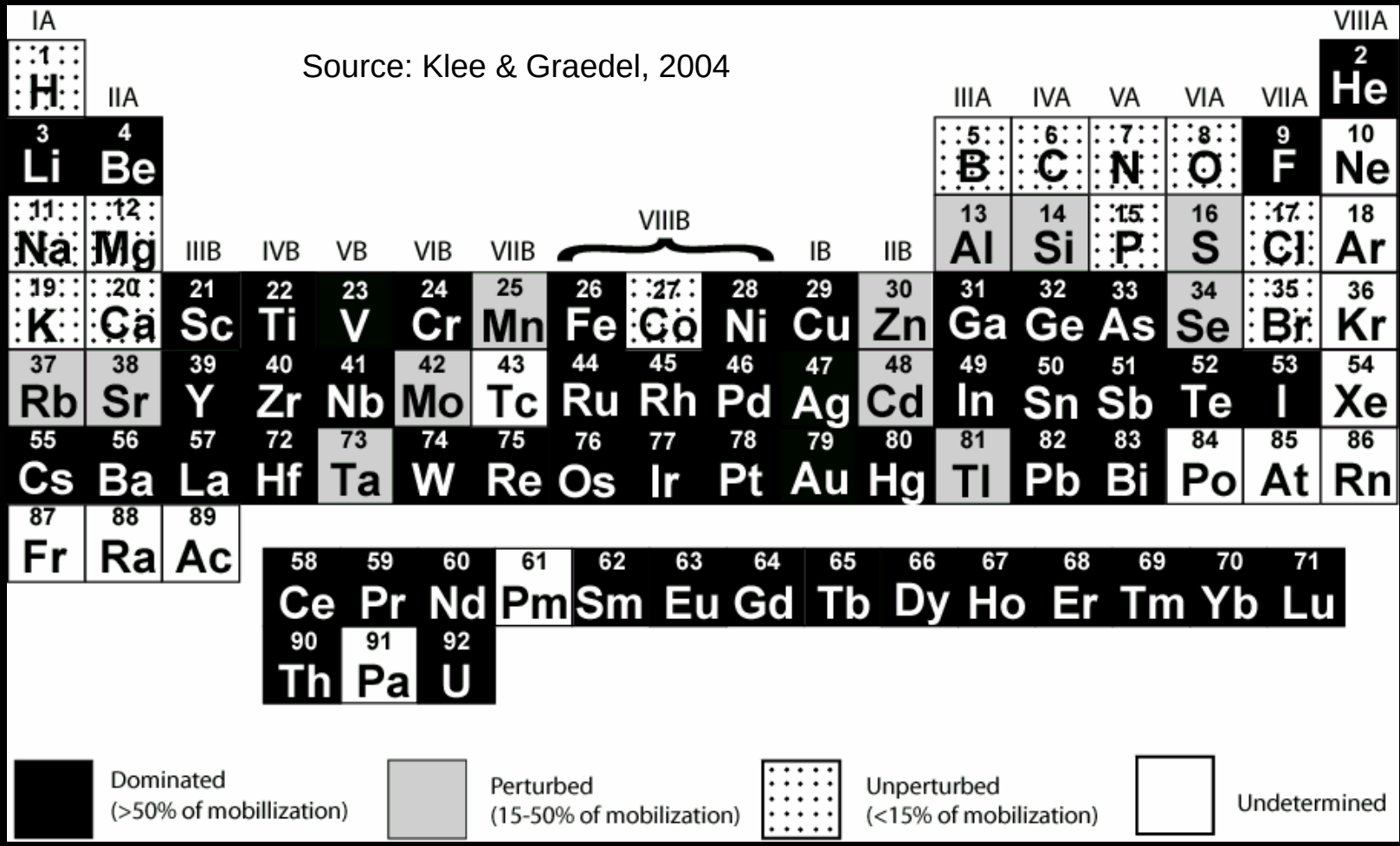
The Contribution of FBC to Optimized Resource and Waste Management

Future Challenges for Waste Combustion and Co-combustion in FBC
May 24 2004, Vienna

Helmut Rechberger
Chair of Resource Management
Institute for Water Quality and Waste Management
Vienna University of Technology
www.iwa.tuwien.ac.at

designed by Inge Hengl

Anthropogenic vs. geogenic mobilization

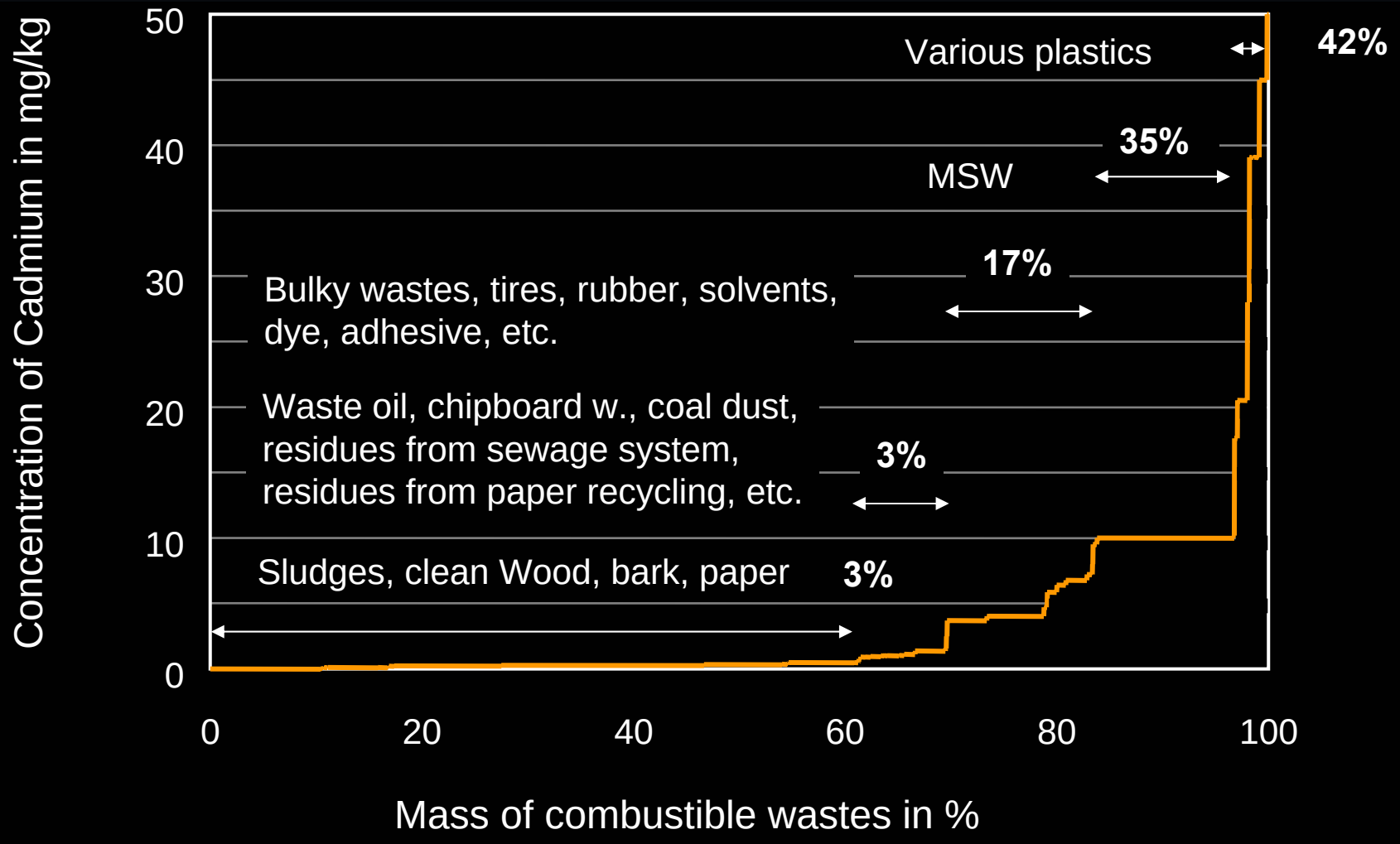


Generation of combustible wastes

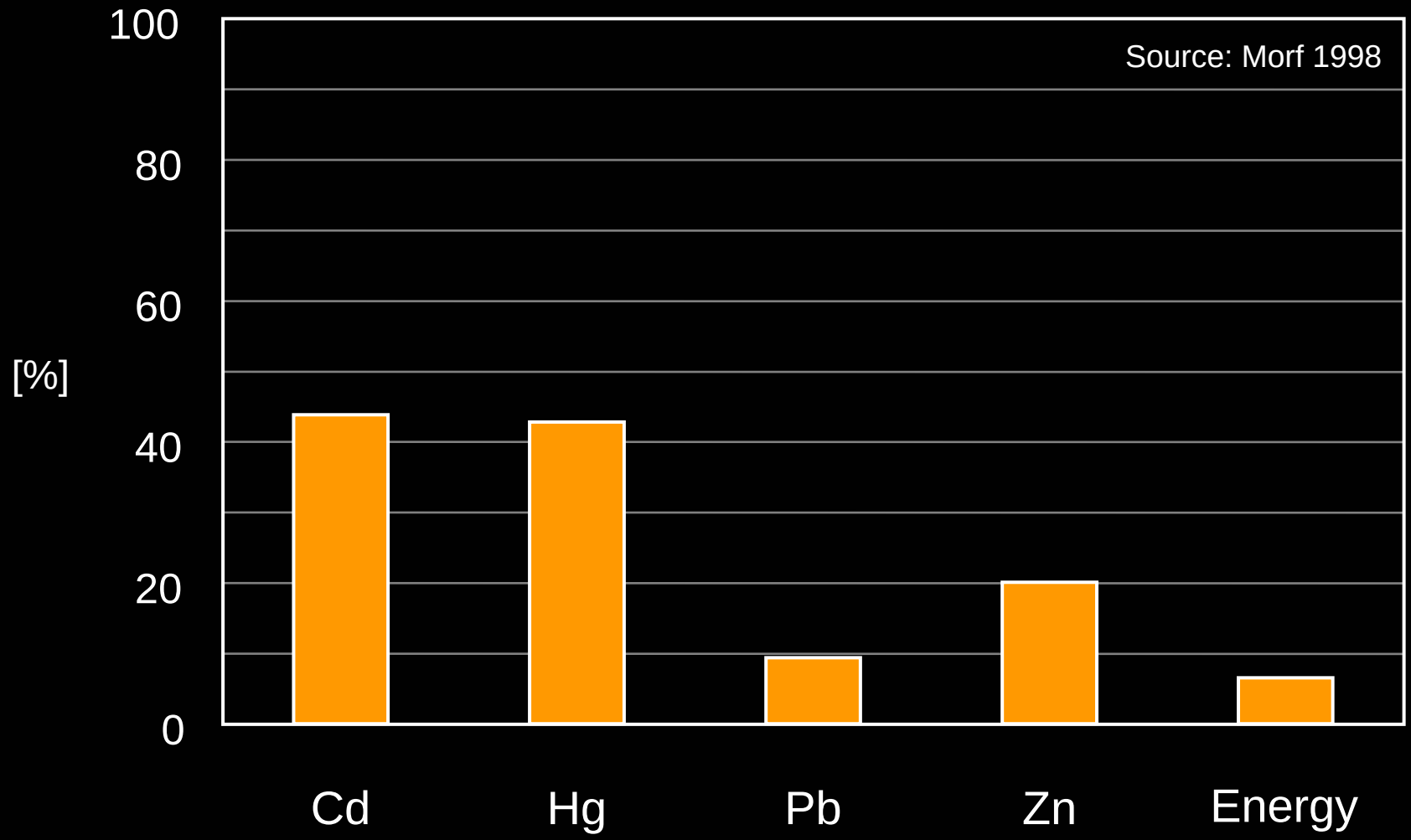
Waste categories	t/(c.yr)	% combustible	t/(c.yr)
• Municipal solid waste	0.31	87	0.27
• Construction & demolition waste	3.00	2	0.06
• Wastes of water purification & waste water treatment (34%DM)	0.29	41	0.12
• Wood & timber wastes	0.44	100	0.44
• Industrial wastes	1.00	14	0.14
• Hazardous wastes	0.14	22	0.03
Total	5.20	22	1.10

Source: Fehringer et al. 1997

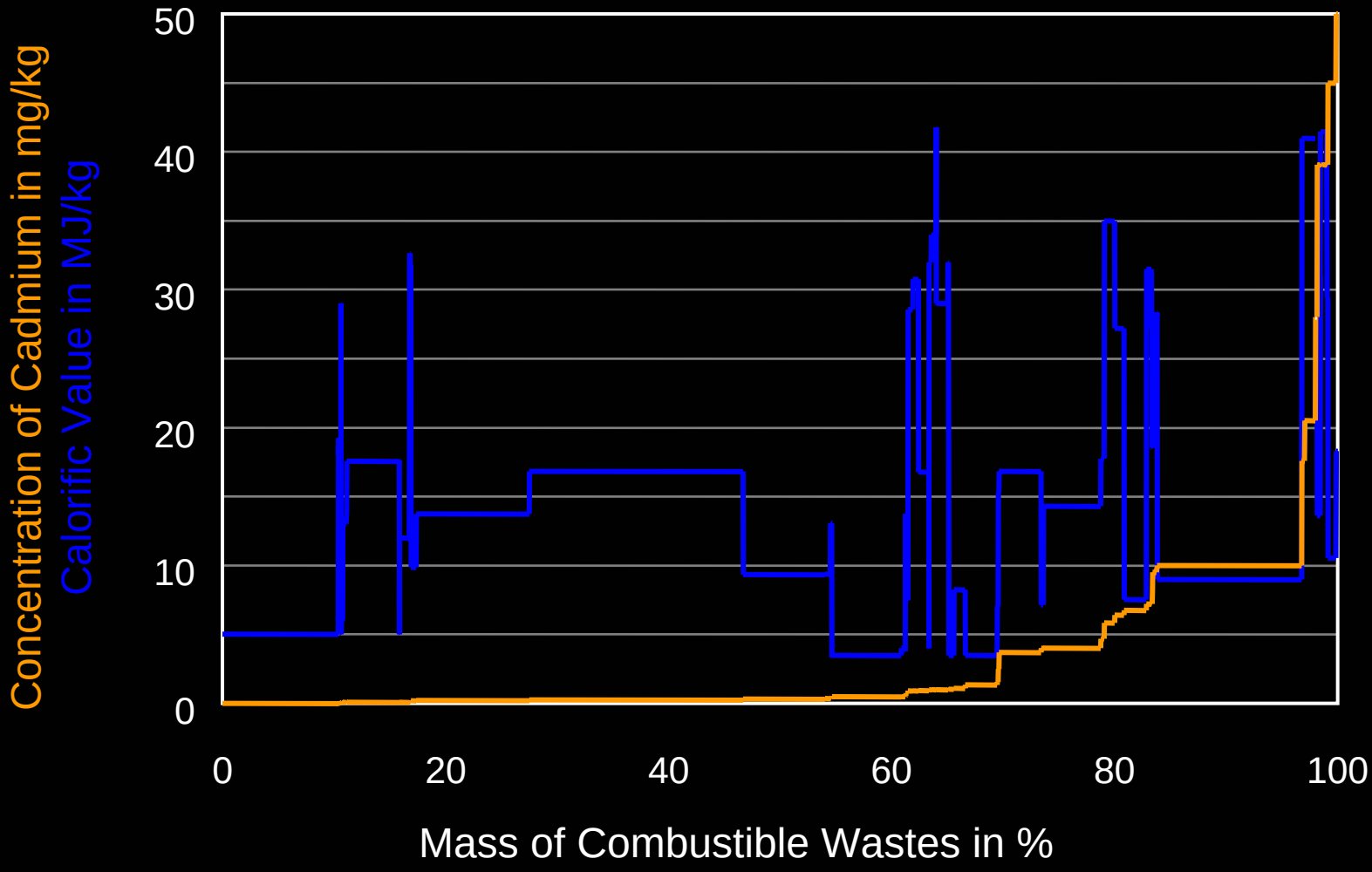
Contamination by Cadmium



Relative flow of HM via combustible wastes
(100% = national consumption)



No correlation between HM and calorific value



Introduction to Statistical Entropy Analysis (SEA)

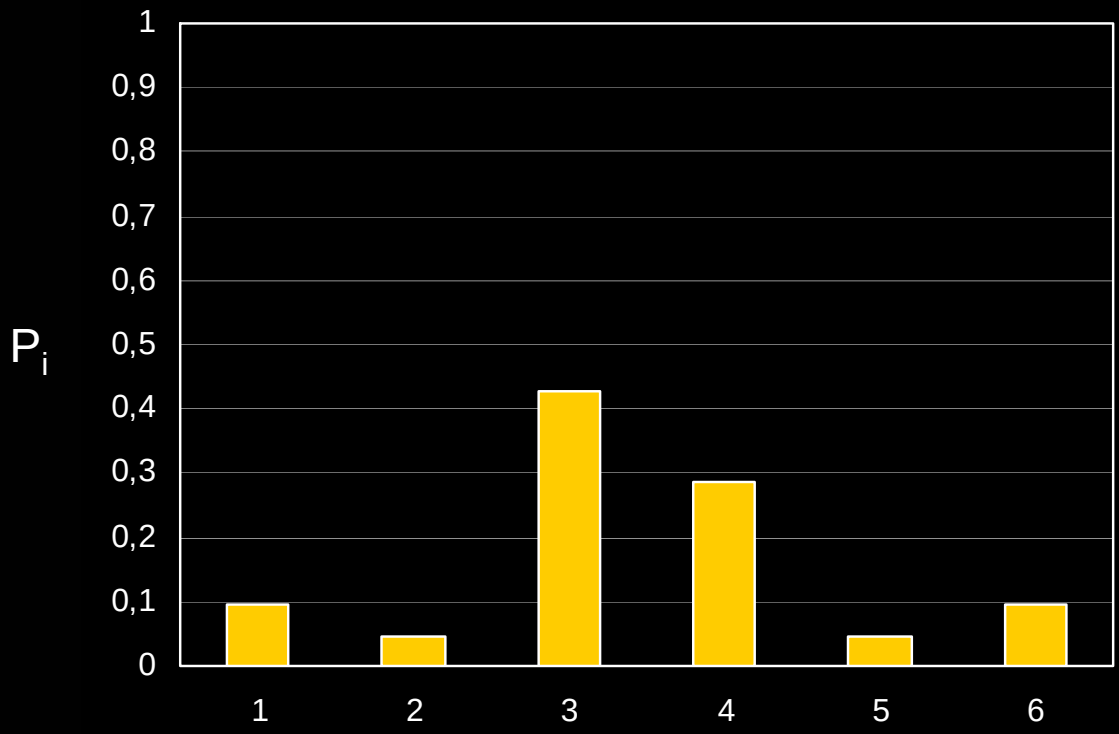
- **Statistical entropy quantifies distribution patterns (statistics)**
- **Statistical entropy ≠ thermodynamic entropy**
- **SEA is published**

  Rechberger, H., Brunner, H.P. A new, entropy based method to support waste and resource management decisions. *Environmental Science and Technology*, 2002, Vol. 34, No. 4, 809-816.

  Rechberger, H., Graedel, T.E., The European copper cycle: statistical entropy analysis. *Ecological Economics*, 2002, Vol. 42, No. 1-2, 59-72.

Distribution patterns: statistics

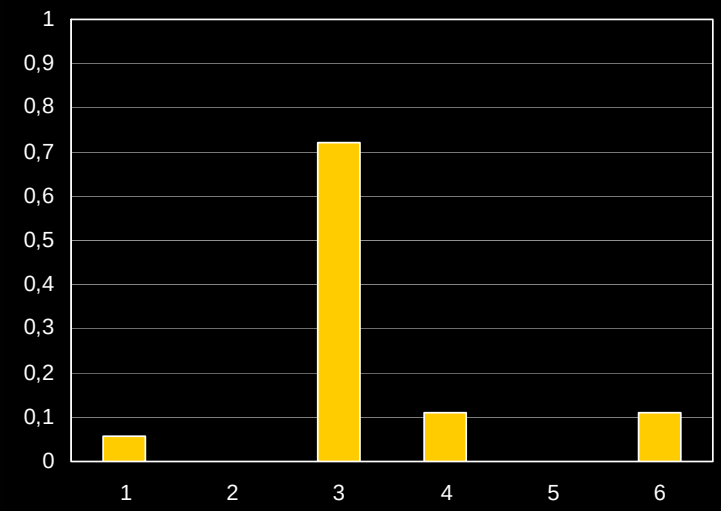
$$H_{rel} = - \sum_{i=1}^{k} (P_i \log_2(P_i))/\log_2(k)$$



$0 < H_{rel} < 1$

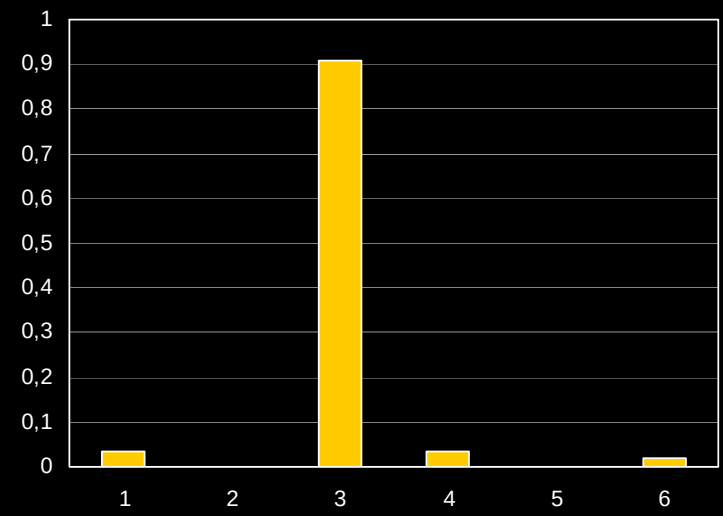
$H_{rel} = 0.81$

Distribution patterns: statistics

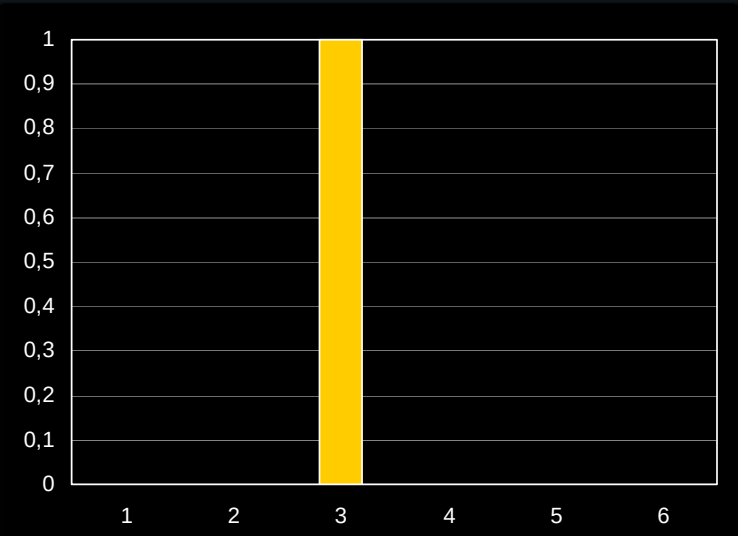


$H_{rel} = 0.49$

$H_{rel} = 0.22$

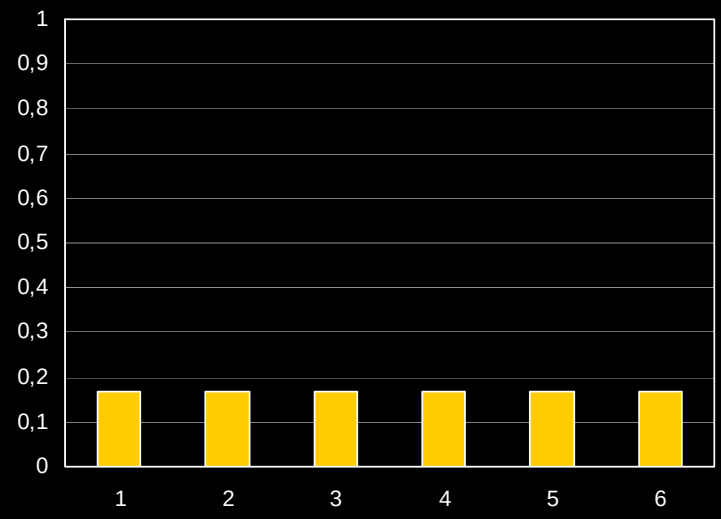


Distribution patterns: statistics



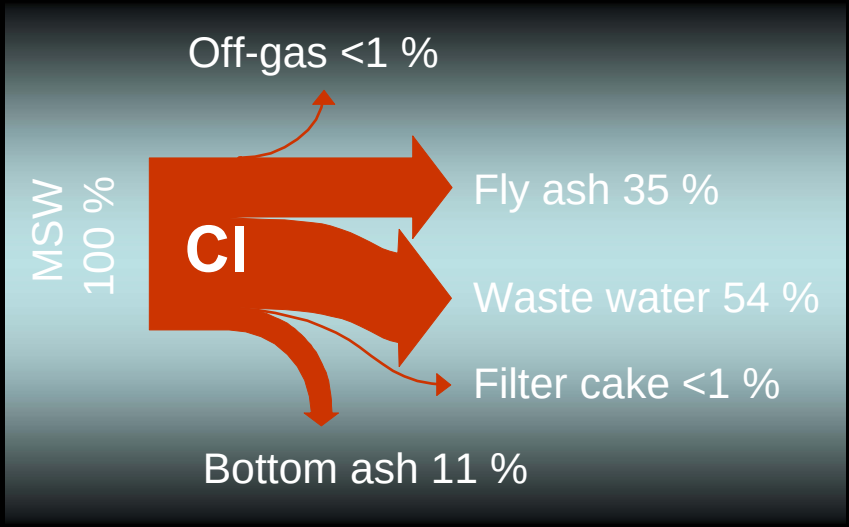
$H_{rel} = 0$
Minimum

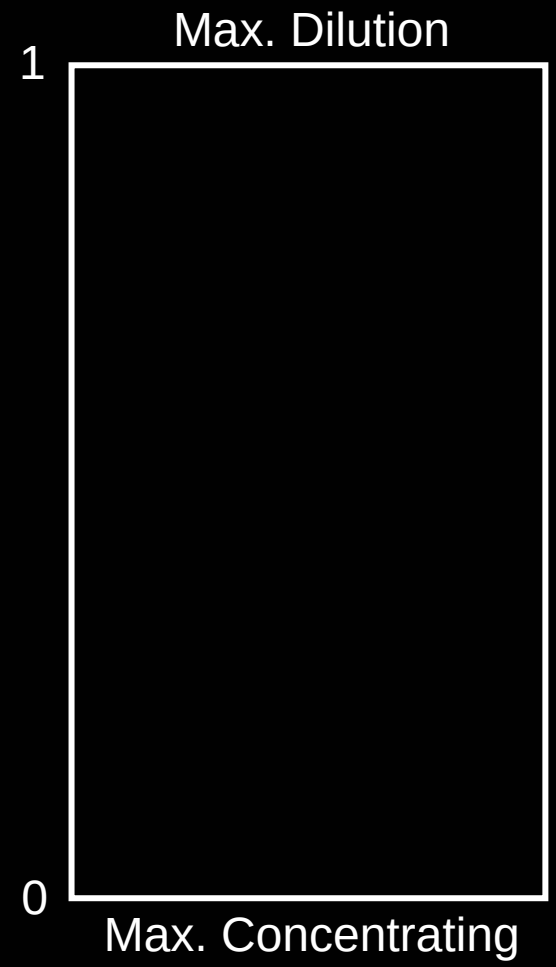
$H_{rel} = 1$
Maximum



Distribution patterns: combustion

Example Chlorine





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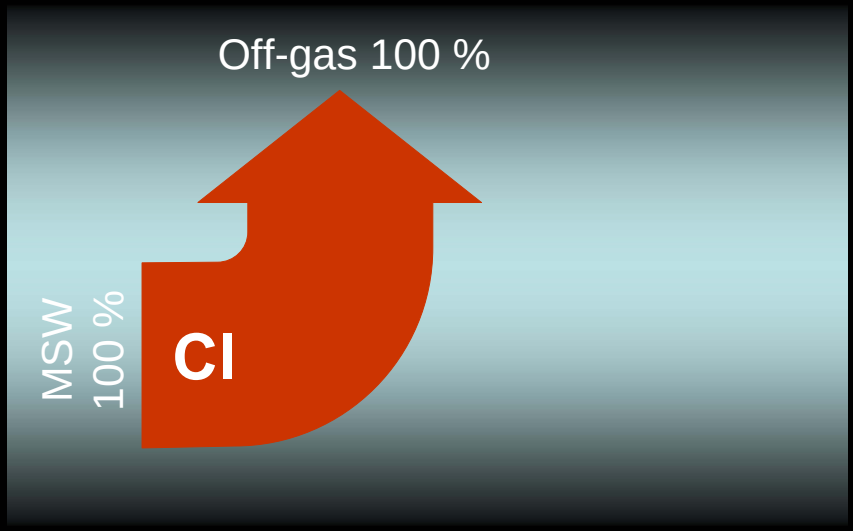

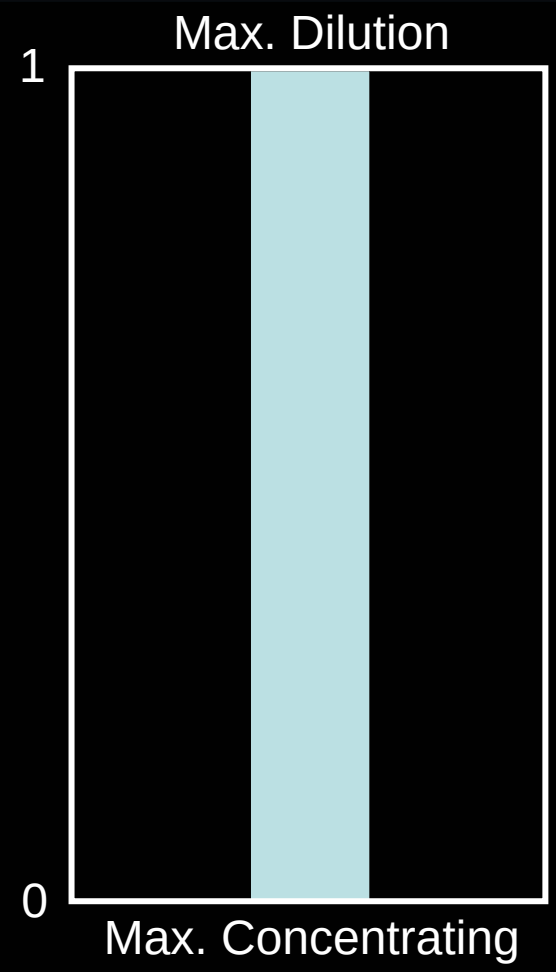

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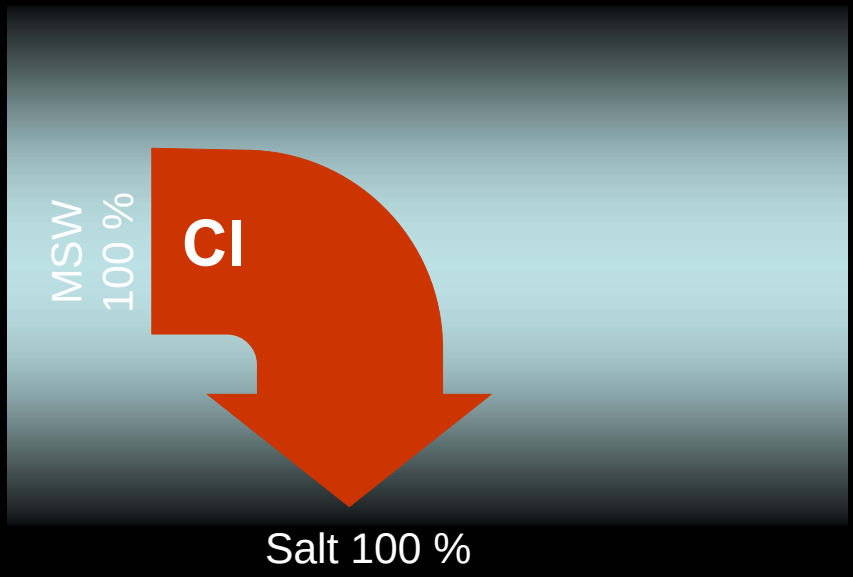

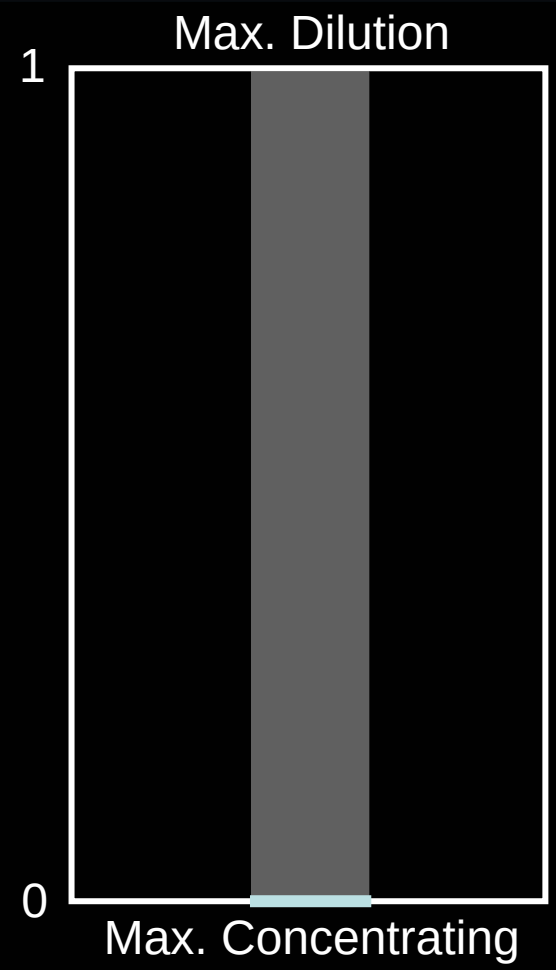

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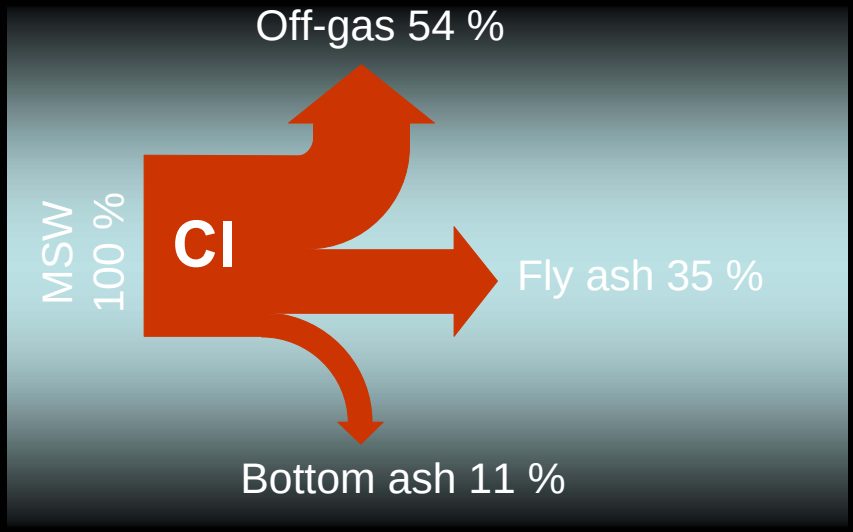

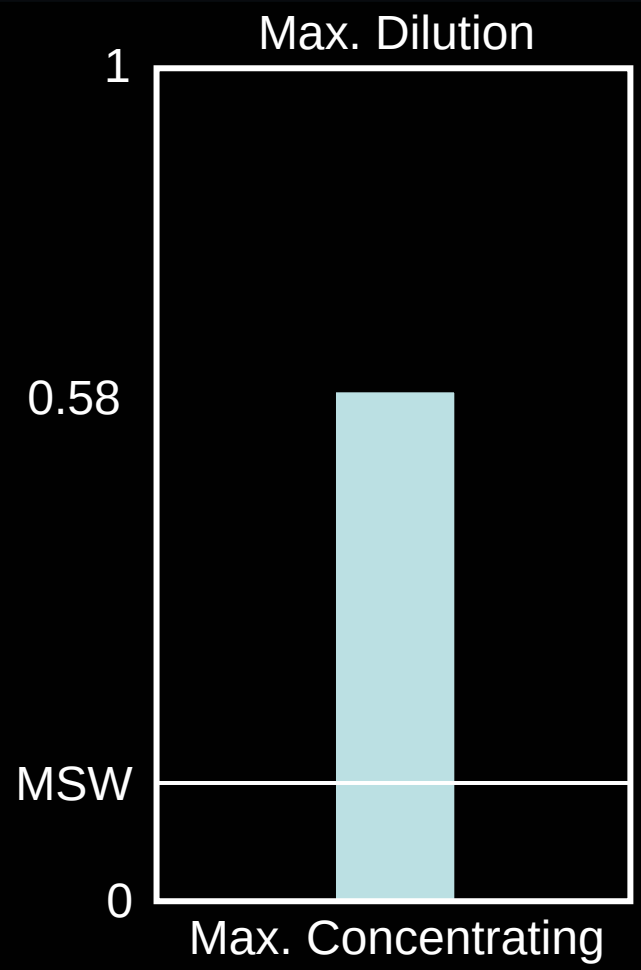

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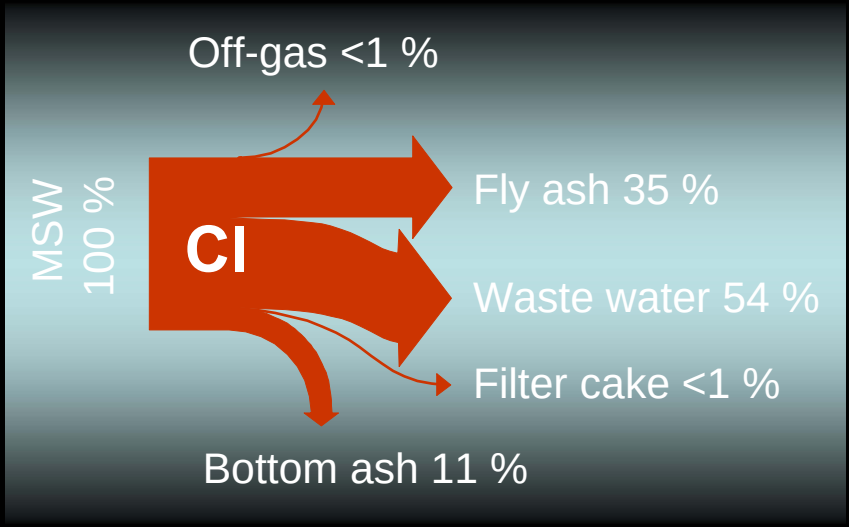

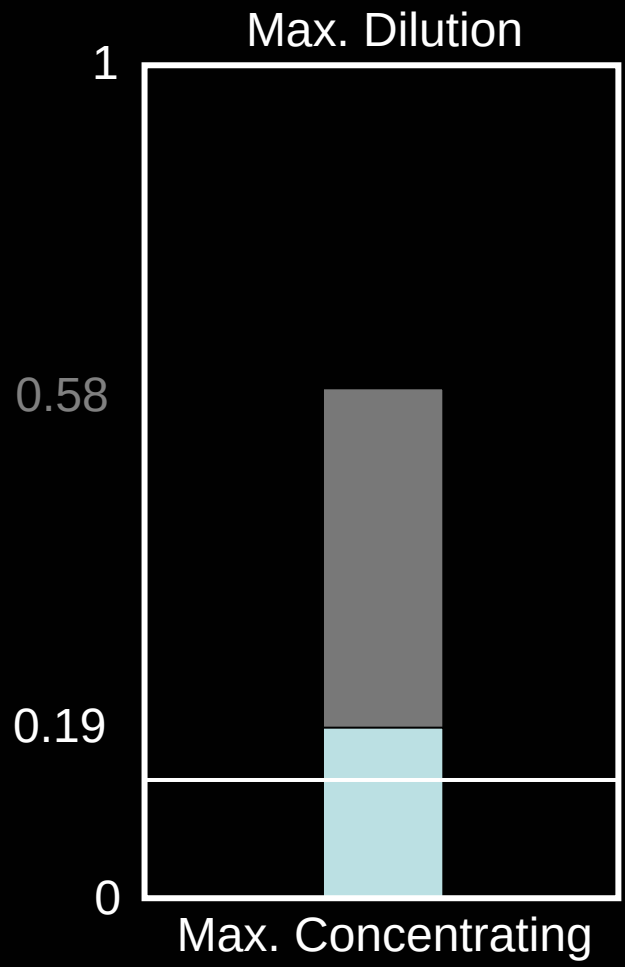

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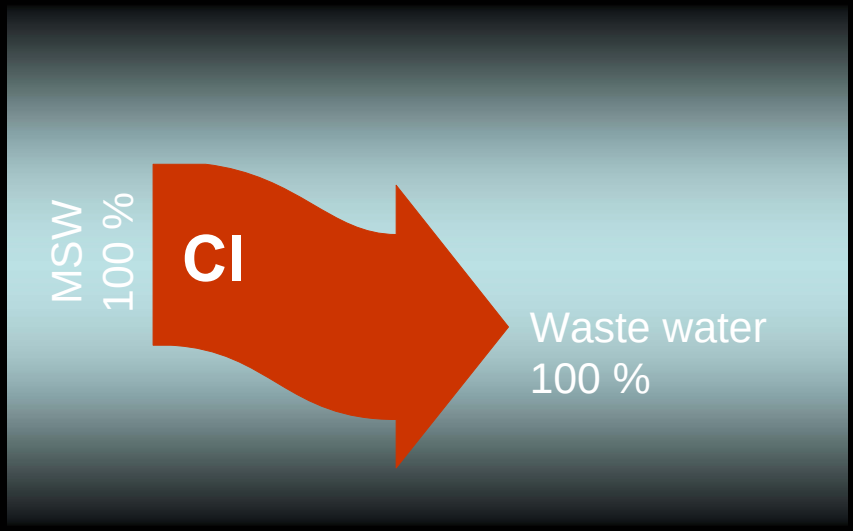
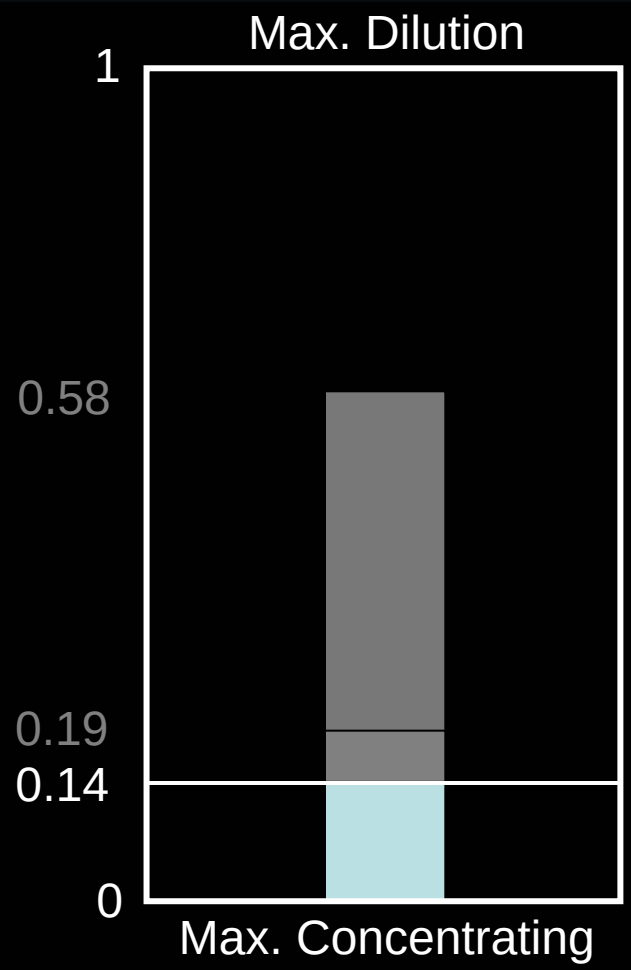
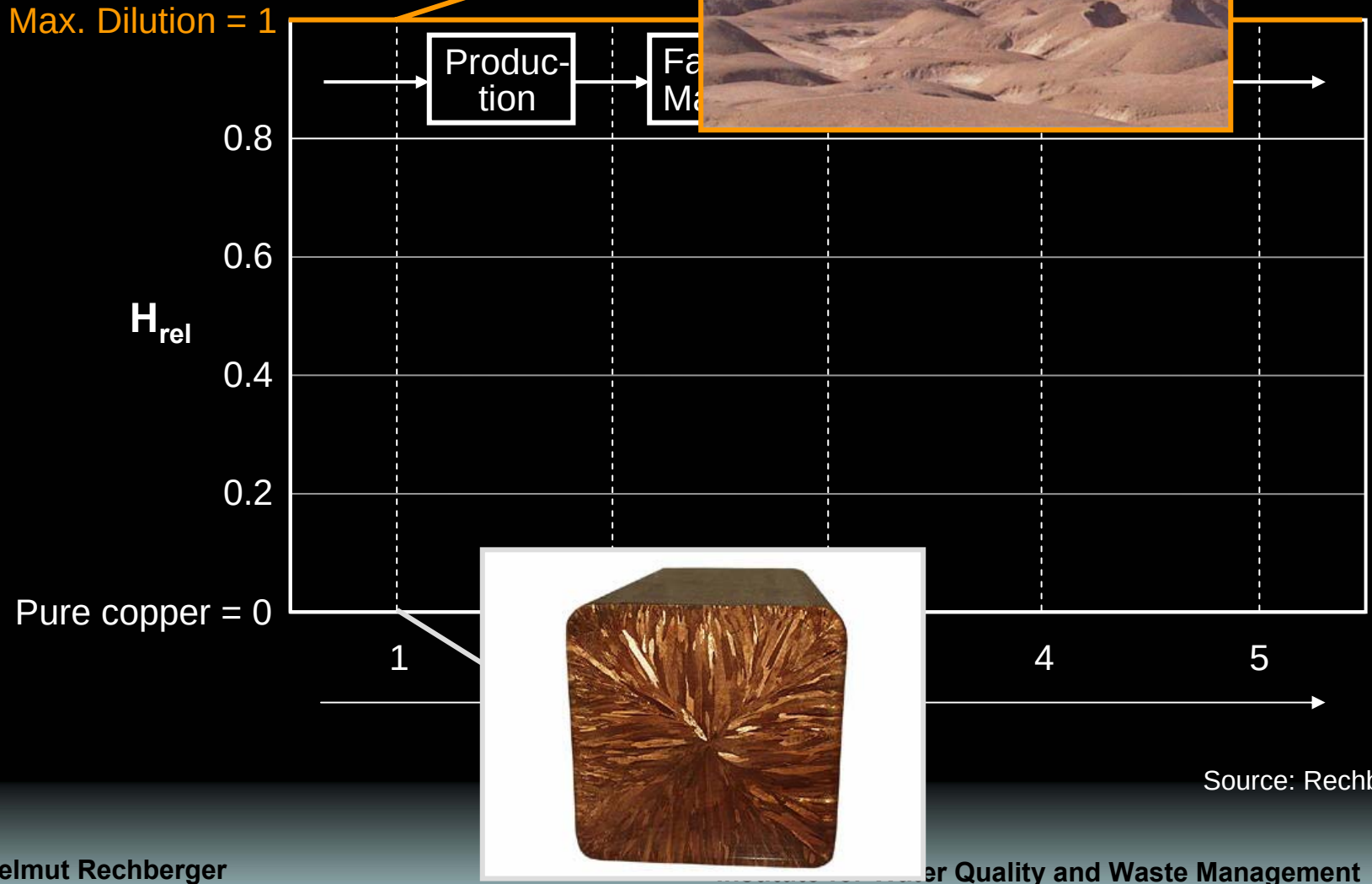


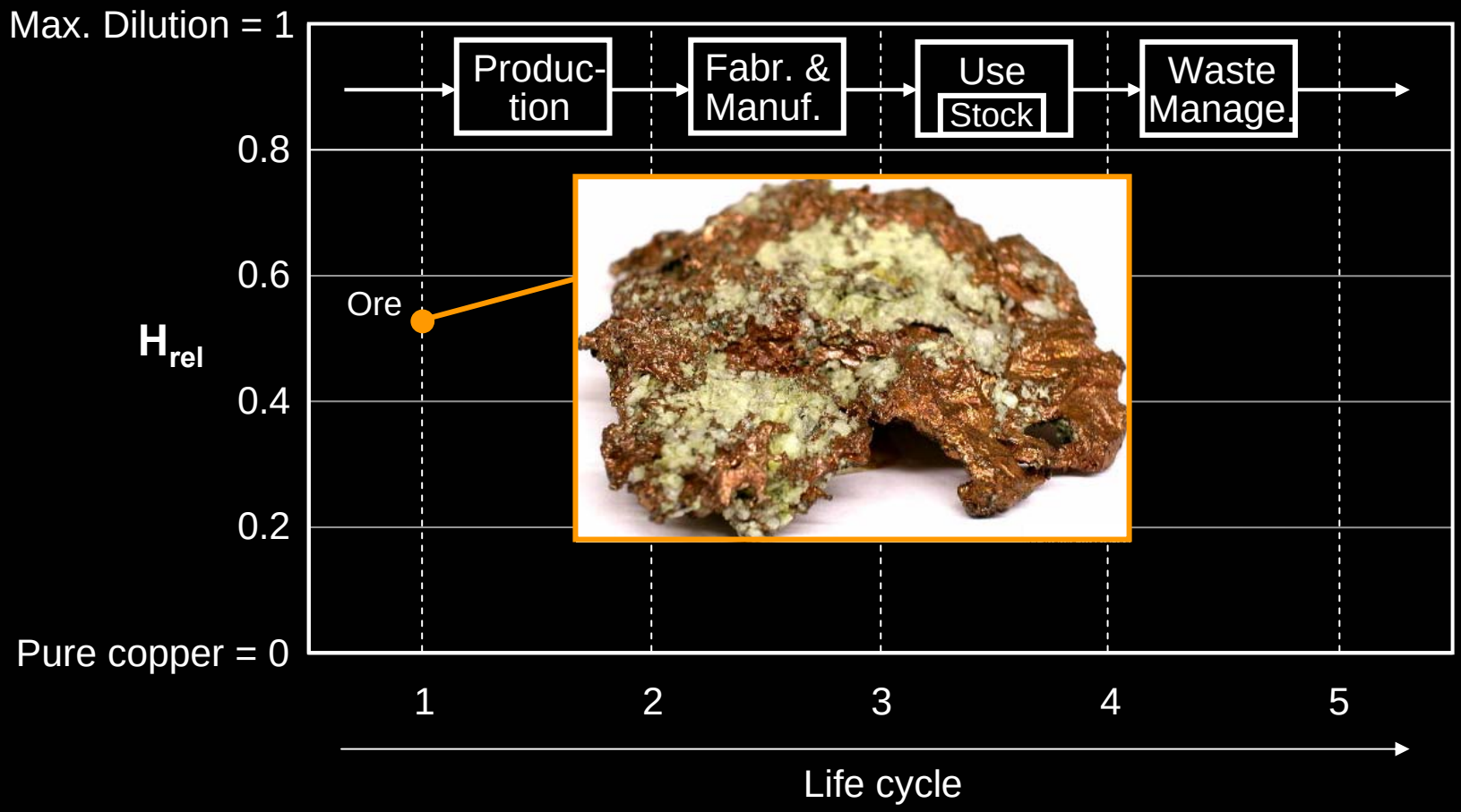


SEA of global cop



Source: Rechberger, 2003

SEA of global copper flows



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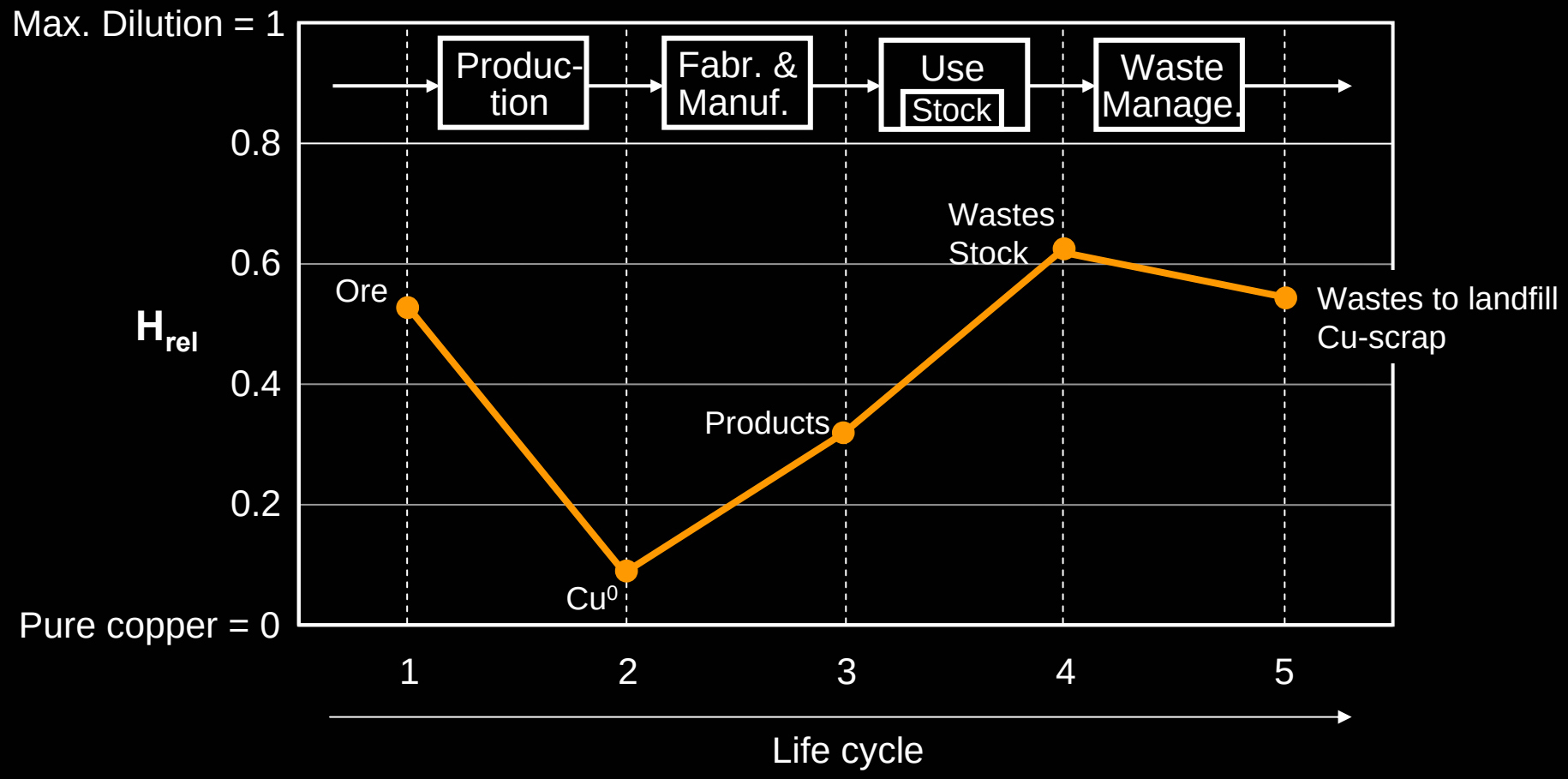

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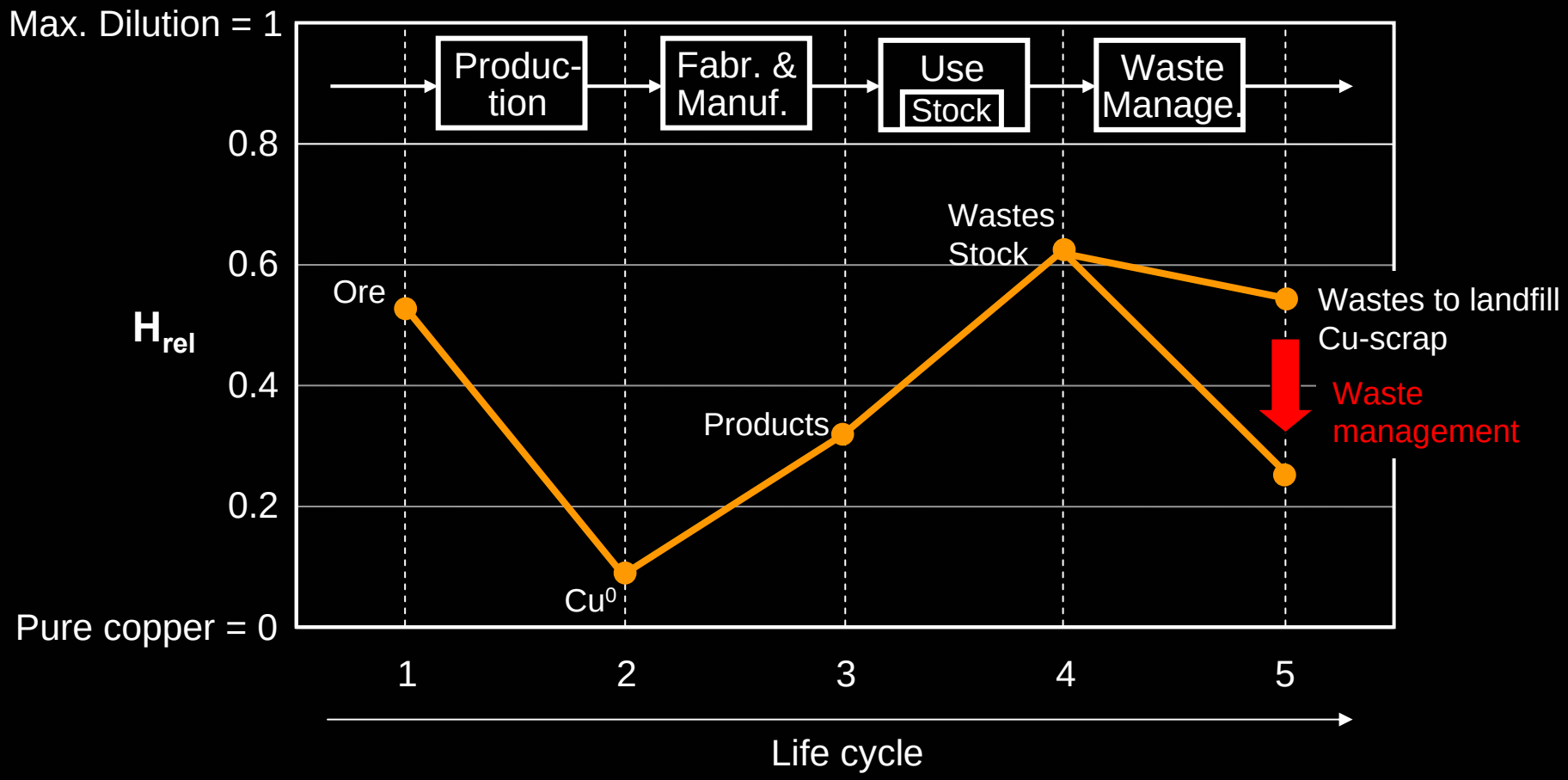

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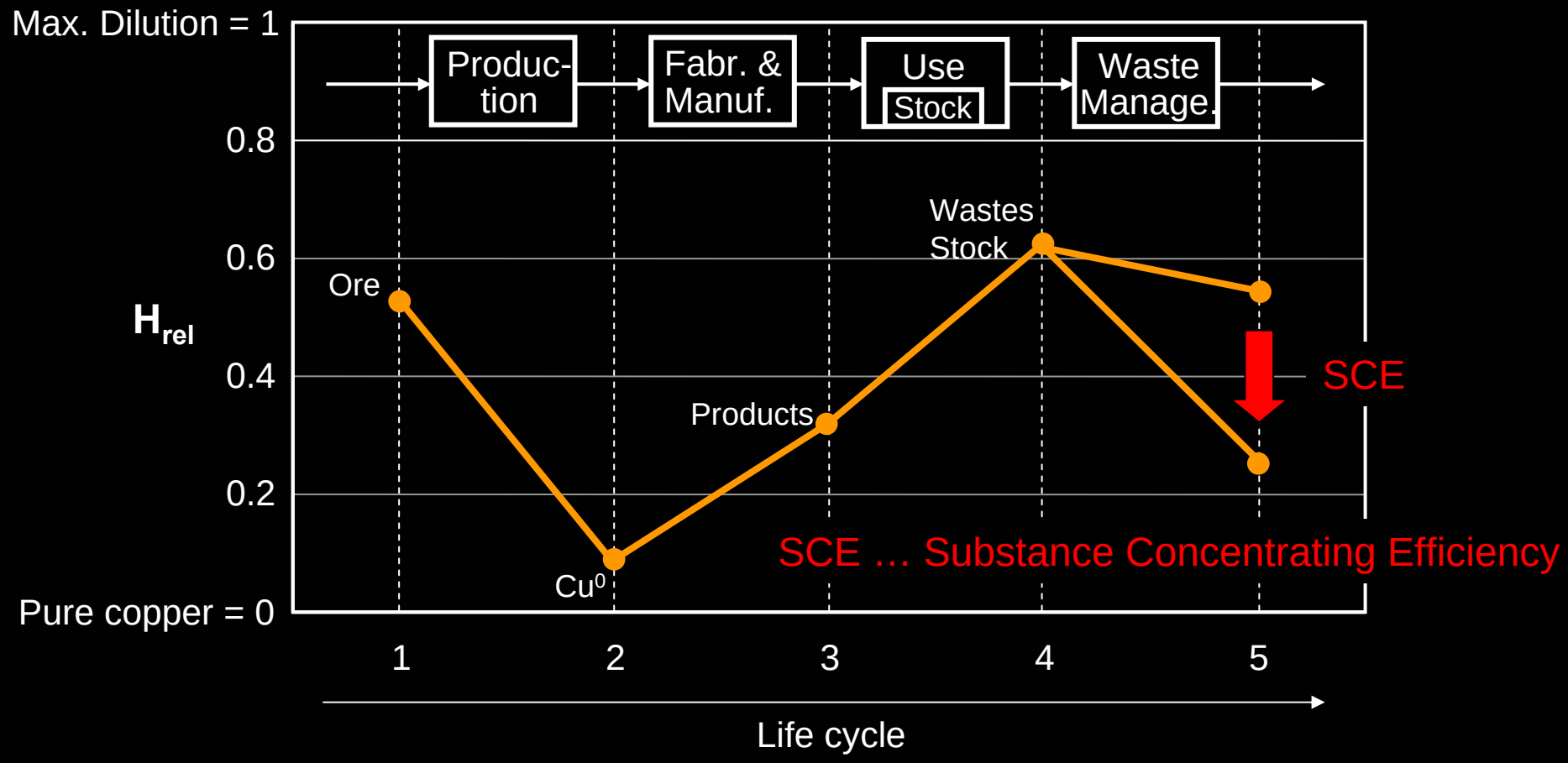

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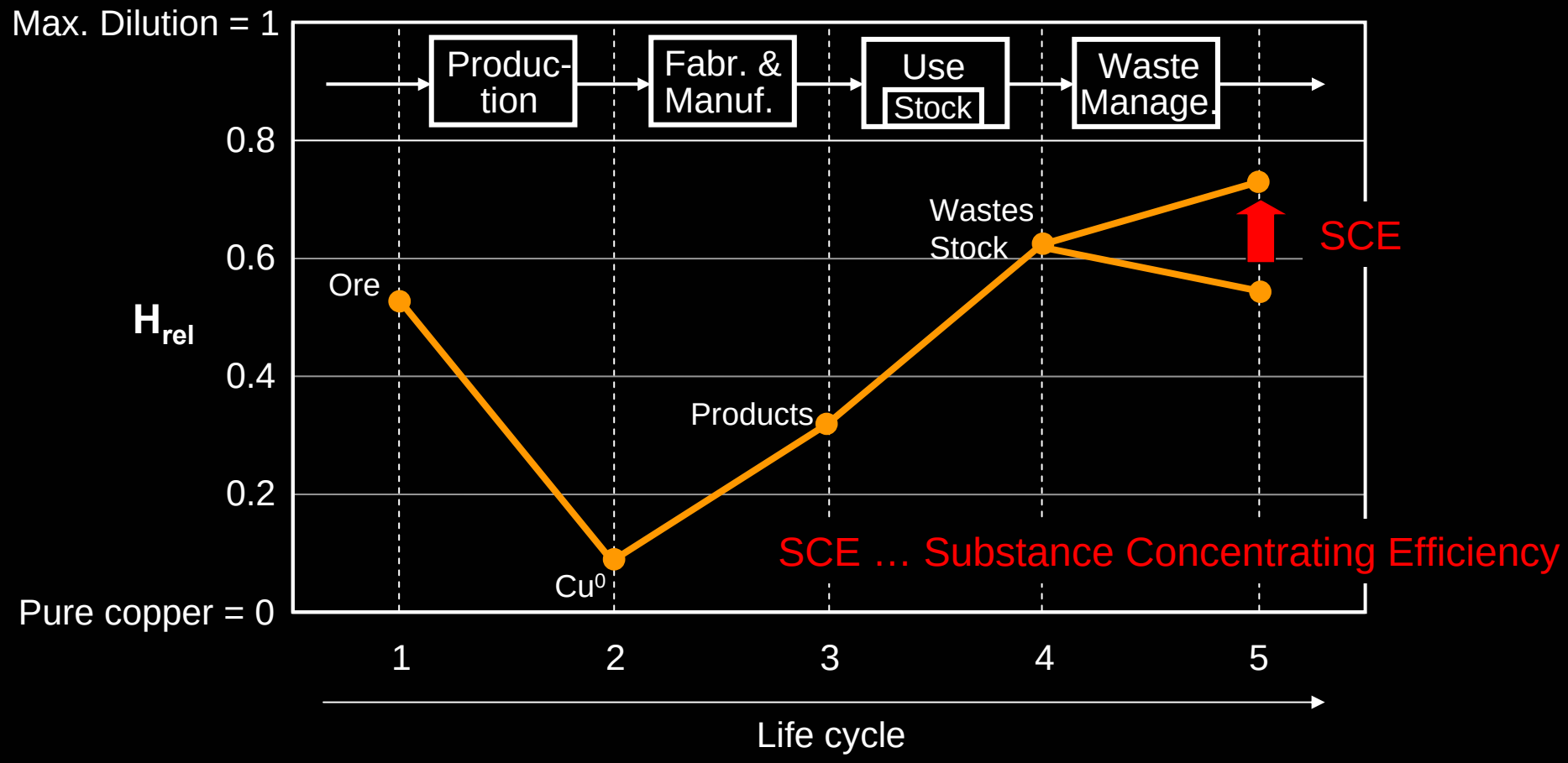
SEA of global copper flows



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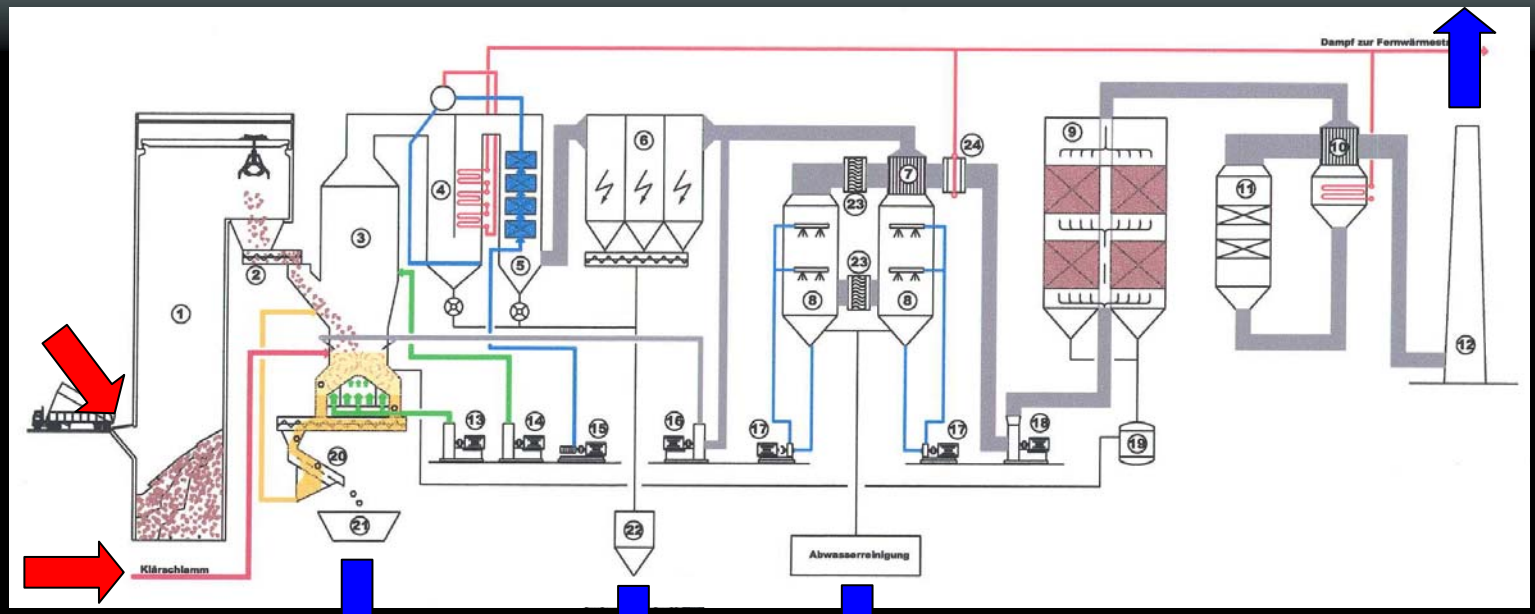
Substance concentrating efficiency (SCE)



Concentrating process

Diluting process

Requirements for high SCE-values

- Low emissions to the environment
- High-concentrated residues (low volume)
- Earth-crust like residues

Benefit of the indicator SCE

- Quality of substance mgmt. is quantified
- Comparability of technologies
- Indicator for efficiency

Efficiency of technologies