Kanton Zürich
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AWEL

Waste and resource management: the sink approach of Canton Zurich

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ISWA International Solid Association

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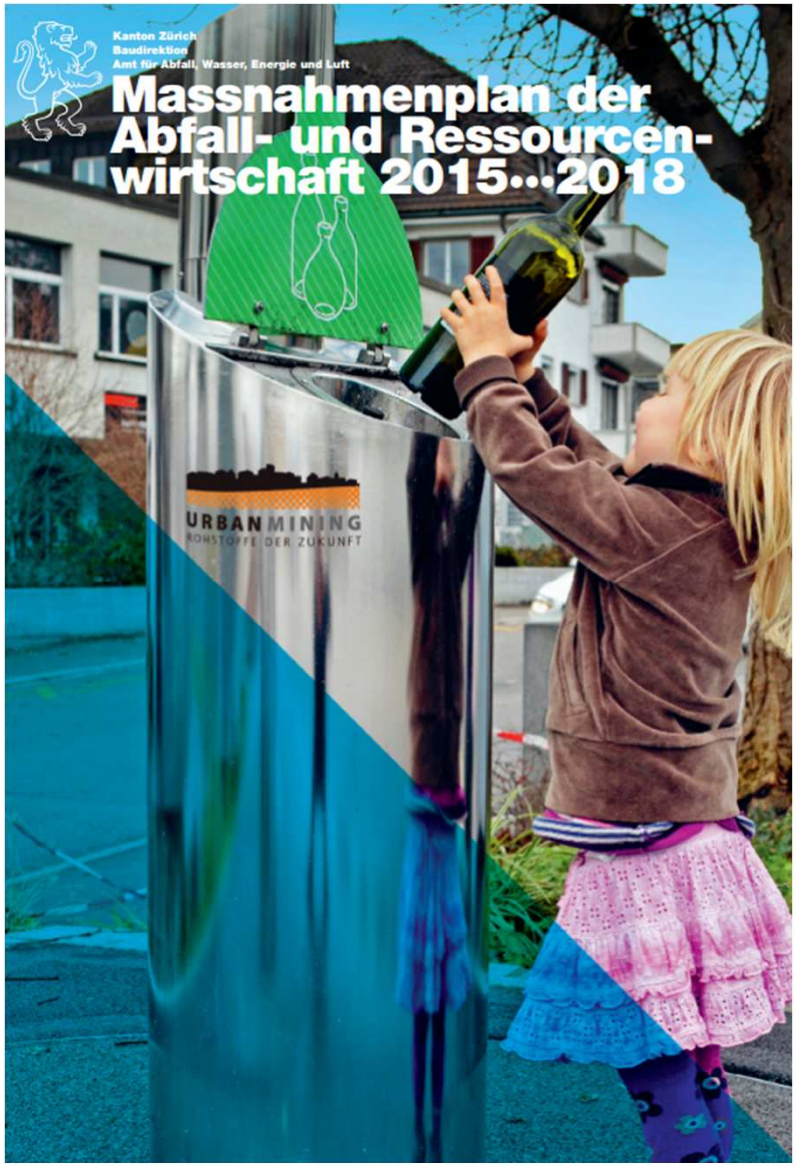


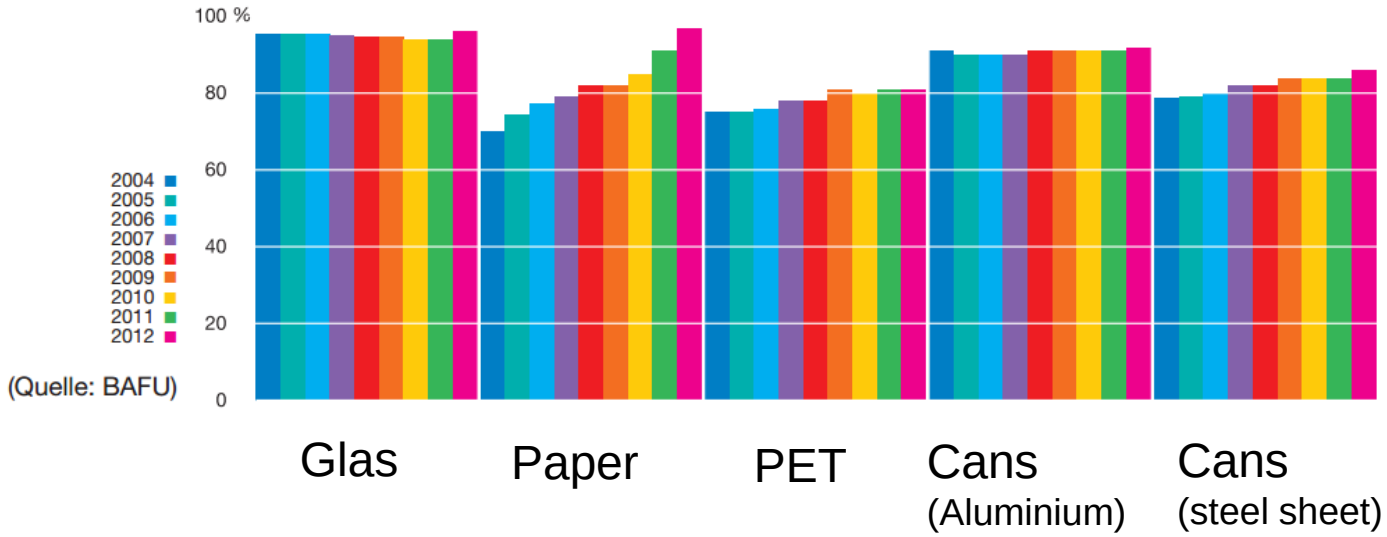
Testimonial:

„Quality ahead of Qantity: The priorty for the economy of waste and ressource management are clean cycles. Pollutants has to be removed und placed in safe last/final sinks.“

Prof. Dr. Paul Brunner, 2015

***First* Activities in Urban Mining in Canton of Zurich**

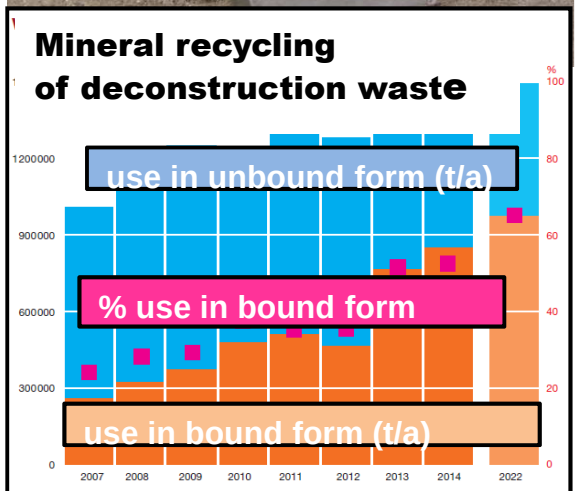
Collection rate



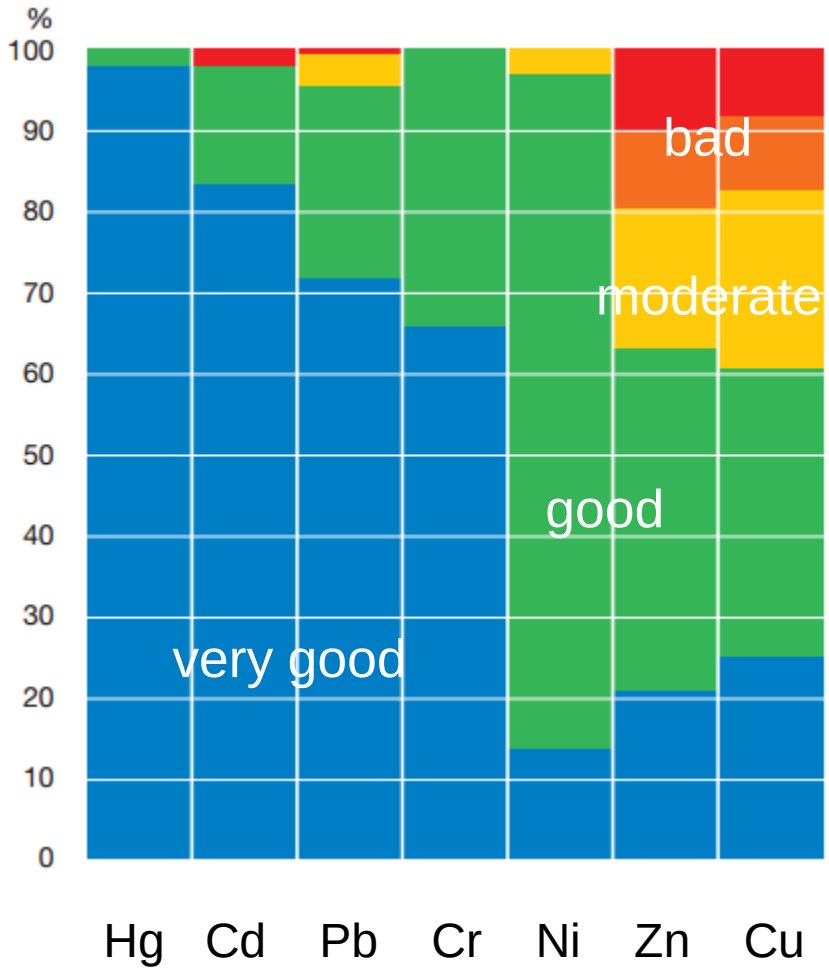
→ One of the leading recycling rates world wide!

Actual new Activities in Urban Mining in Canton of Zurich

- **Reclaiming phosphorous from sewage sludge**
- **Extraction ferrous and non-ferrous metals from municipial solid waste incineration slag**
- **Recovery of heavy metals such as zinc, cadmium and lead from waste incineration filter ash**
- **Increasing the recycling rate of C&D Waste (80%)**



Do we have problems with sinks?



Heavy Metals in River Water Sediment (2004-2011)

Close to 40% of investigated areas fail good conditions related to Zinc and Copper (Canton Zurich)

Zürcher Gewässer 2012, Entwicklung-Zustand-Ausblick (S. 25), AWEL, 2013

Questions of this study

(1) What sinks are available to accomodate waste? (Cu, Zn, PAK, brominated Diphenylethers)

(2) To what extent does economic activity fill up the capacity of these sinks, and what proportion is accounted for by the waste management sector? [Analysis]

(3) Are shortages in the sinks' capacity for waste to be expected? [Evaluation]

(4) Might any capacity shortages be resolved by source-based and/or alternative waste management processes? [Measures]

Methodical Aspects

Material Flow Analysis (1)

- Material Flow physical transfer of material from one process to another process

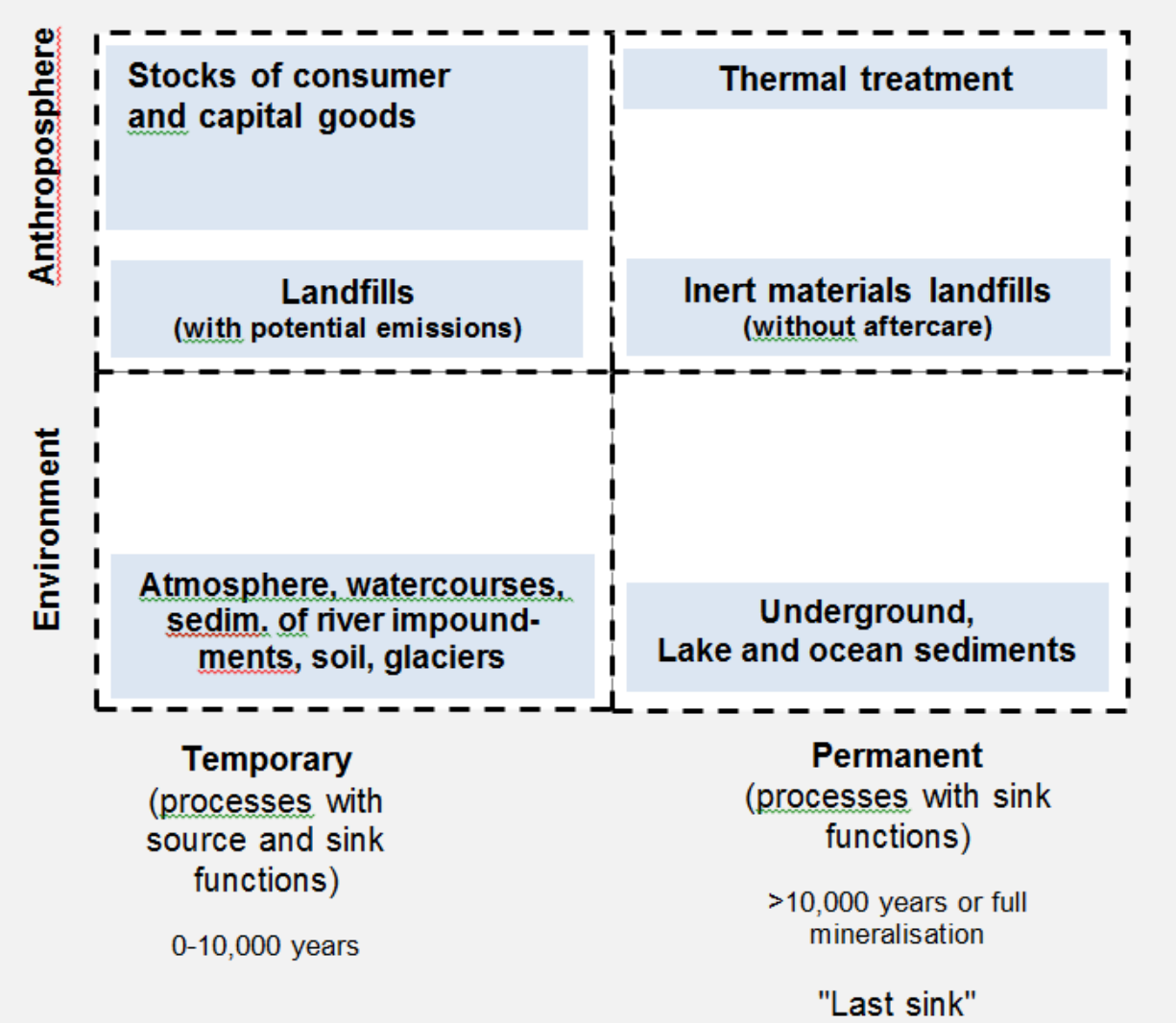
- Process: is spatial and timely limited and part of the Equation of the Material Flow Analysis [e.g. tons/year]

Equation (process terms):

Sink = Input – Output + Source

«Sink» as a Process (Addition to stocks, Forming by Reaction (e.g. Dioxin during burning process)

Sink classification scheme (2)



Methodic of Assessement (3)

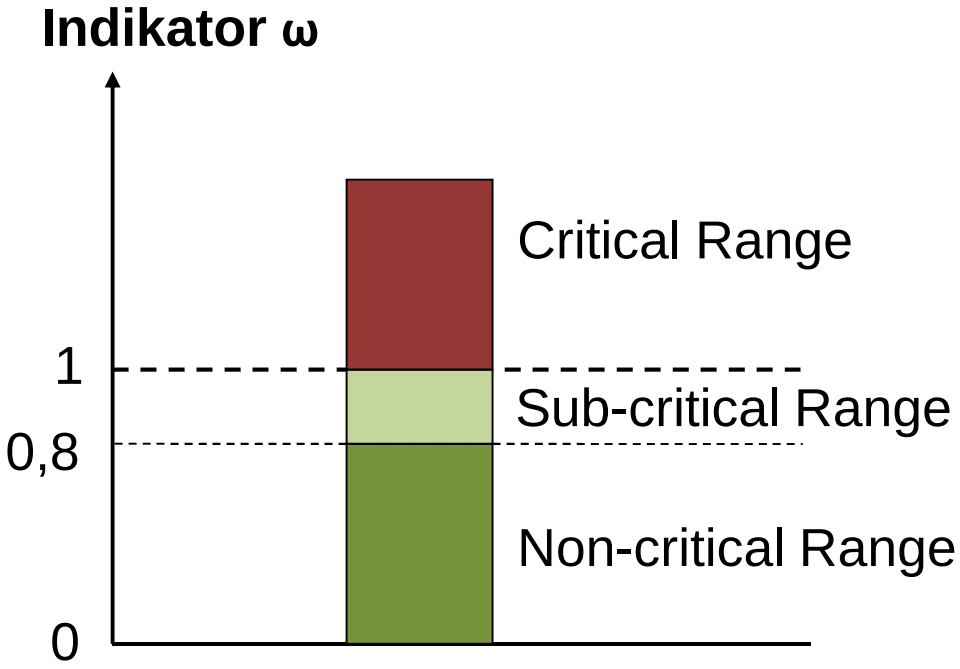
a) The acual flow is compared with the critical flow

b) The critical flow was derived from

- **applicable environmental law or**
- **goals in the «Action plan for Waste and Resource Management, 2015-18» of Canton Zurich or**
- **the descripton of State of the Art (AWEL Zurich)**

$$(4)\ \textbf{Indikator}\ \omega = \frac{\textbf{Actual sink capacity utilization for i}}{\textbf{Critical sink capacity utilization for i}}$$

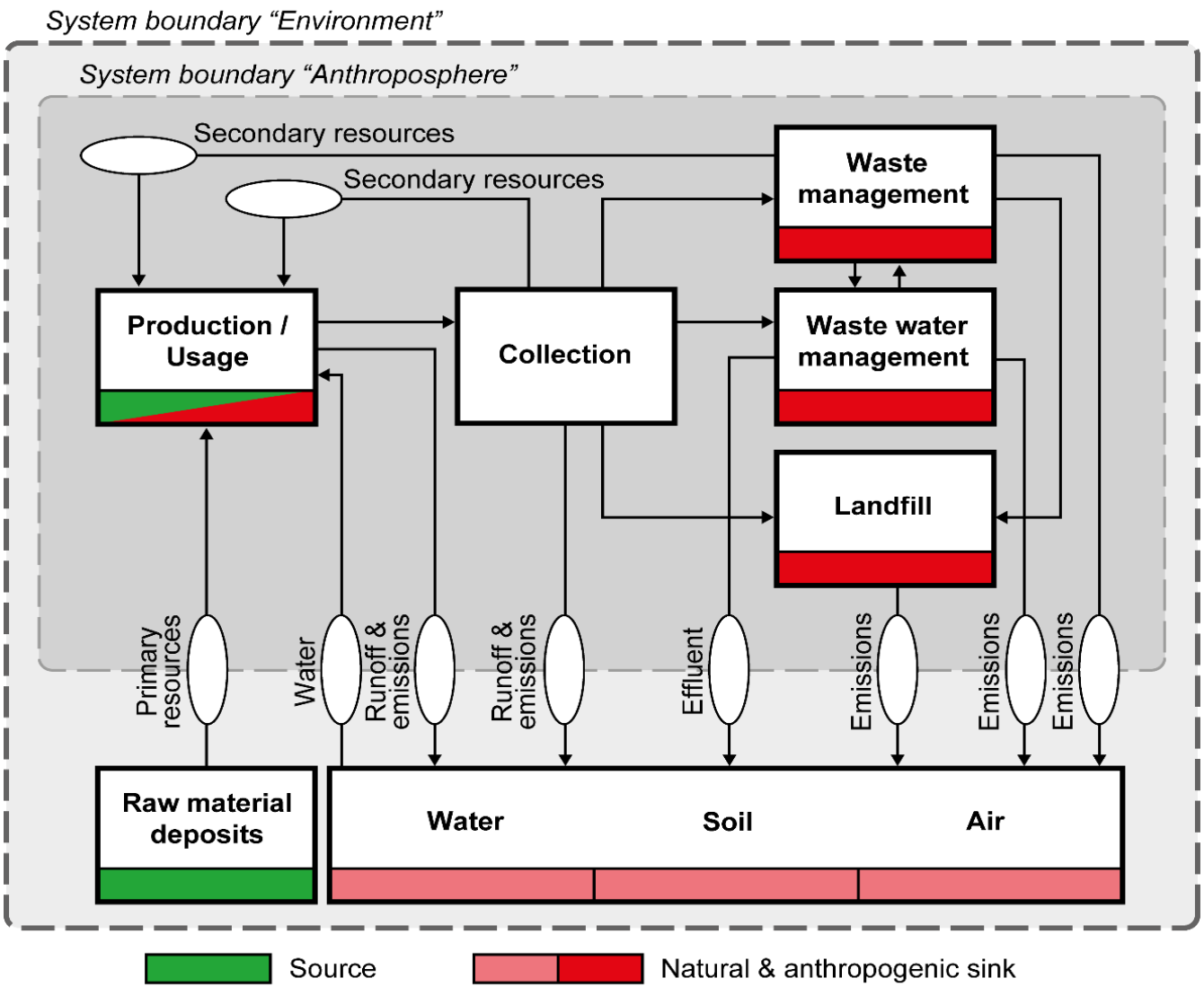
The Variable i is an index for the individual flows



ω is referring to

- Goods or Selected Substances (Cu, Zn, PAH, DecaBDE)
- a certain flow to a sink
- a certain time period

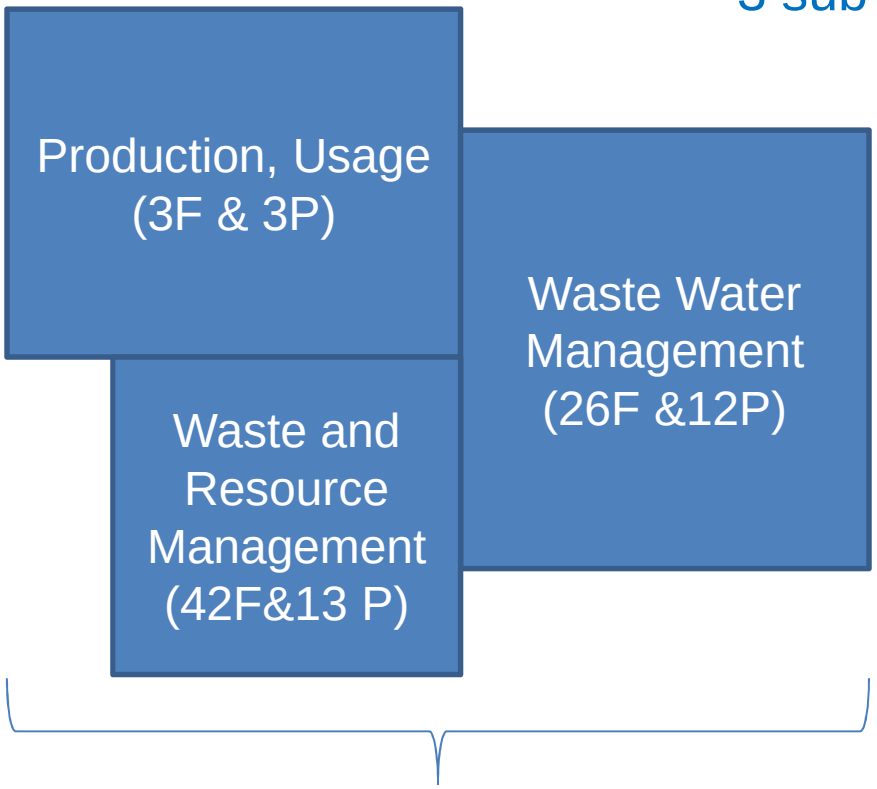
Macroeconomic material flows and their accumulation or mineralisation in natural and anthropogenic sinks (5)



Characterisation System structure (6)

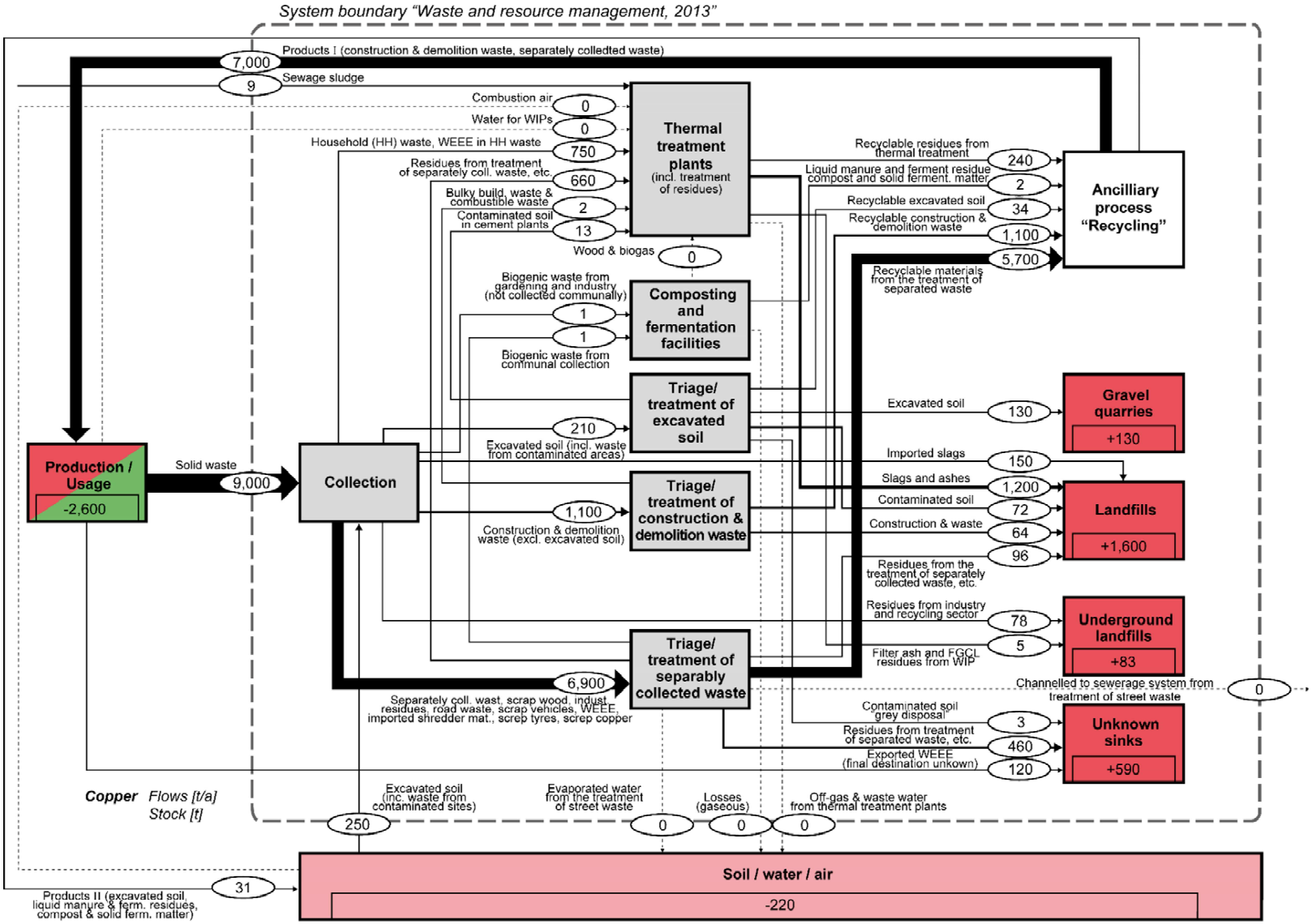
(no of Flows [F] and Processes [P])

3 sub-systems



Overall System 158F & 61P (disaggregated 17 F & 9 P)

Structure of the Waste and Resource Management sub-system for copper (7)



Results

The Sink Approach, Zurich

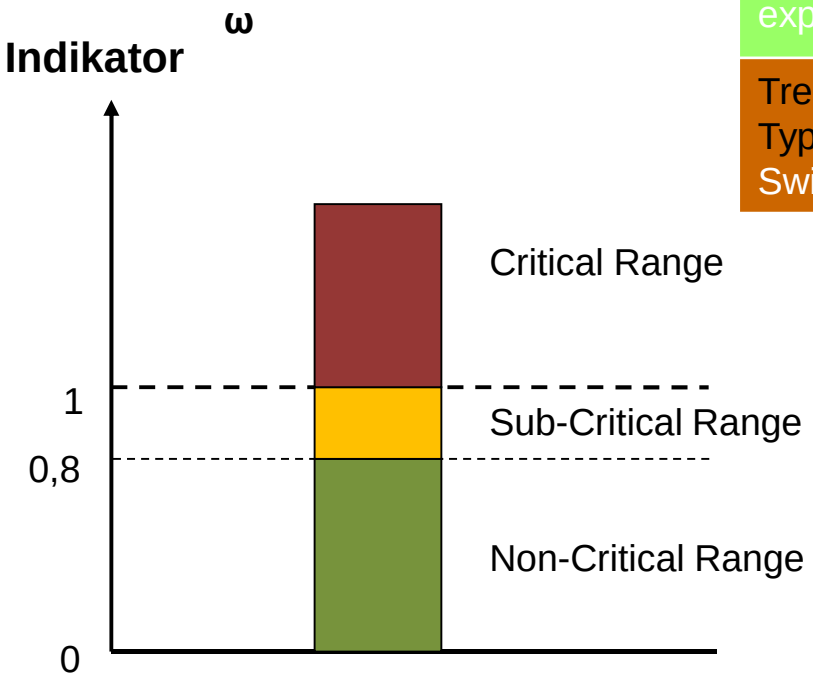
Selected results of "Sink capacity utilisation" for waste in 2013 (1)

Sinks	Goods (mio t/yr)	Cu (t/yr)
Production and usage phase (sinks for recycled secondary raw materials)	2.5	7,000
Thermal waste treatment facilities	6.8[1)]	1,400[1)]
Gravel quarries, landfills	9.9	1,800
Railway routes	$80*10^{-6}$	1
Unknown sinks	$74*10^{-3}$	590
Environmental media	2,400	63
Total sink cap. utilisation	**2,400**	**9,400**

1) To avoid double-counting, the indicated loads were not added to the total sink capacity utilisation

Critical flow for Copper in slag (WIP)

«Critical Flow» defined by following criterium/ szenarium	Actual Flow (t/a)	Crit. Flow (t/a)	ω
Treshold value of landfill Type E complied (actual law for other waste)	900	638	**1.4**
95% metallic Cu revovered (technical possible → expected «State of the art»)	900	473	**1.9**
Treshold value of landfill Type B complied (inertness, Swiss guiding principle)	900	64	14



Critical Flow = Residual copper in treated slug

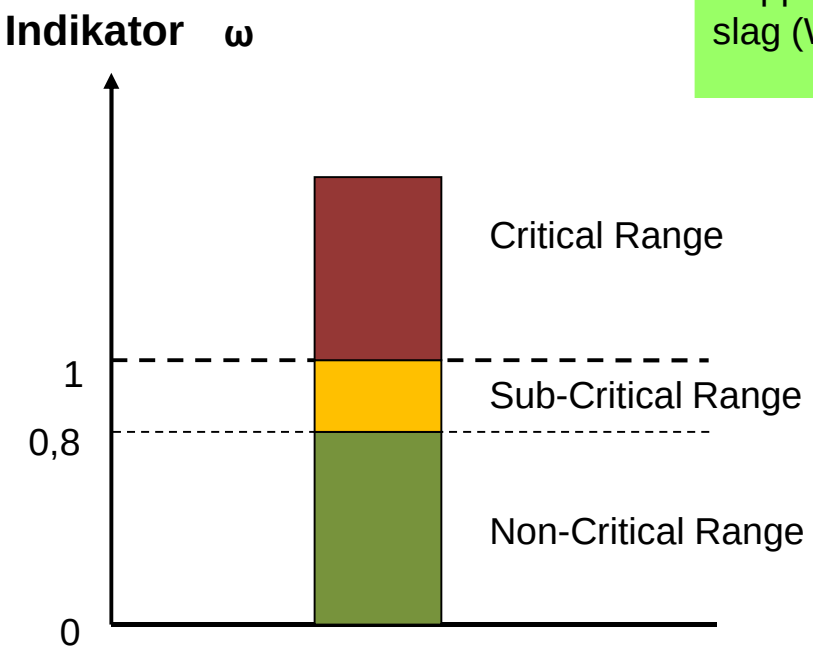
«Thermorecycling»
(ZAV-Recycling AG Hinwil): slag treatment processes

ZAR (foundation)
Developement Center for sustainable management of waste recycling

Clean Circle & functional Recycling

e.g. Copper in iron metalls from slags

Improvement with state of the art	Actual Flow (t/a)	Critical Flow (t/a)	ω
Copper in iron metals from slag (WIP)	220	110	**2.0**



Cupper extraction from extracted iron

?

Conclusions: in general

1) The need for anthropogenic and natural sinks is enormous, at 13 t/yr *capita.

2) Problematic substances should be channelled out to maintain high-quality cycles.

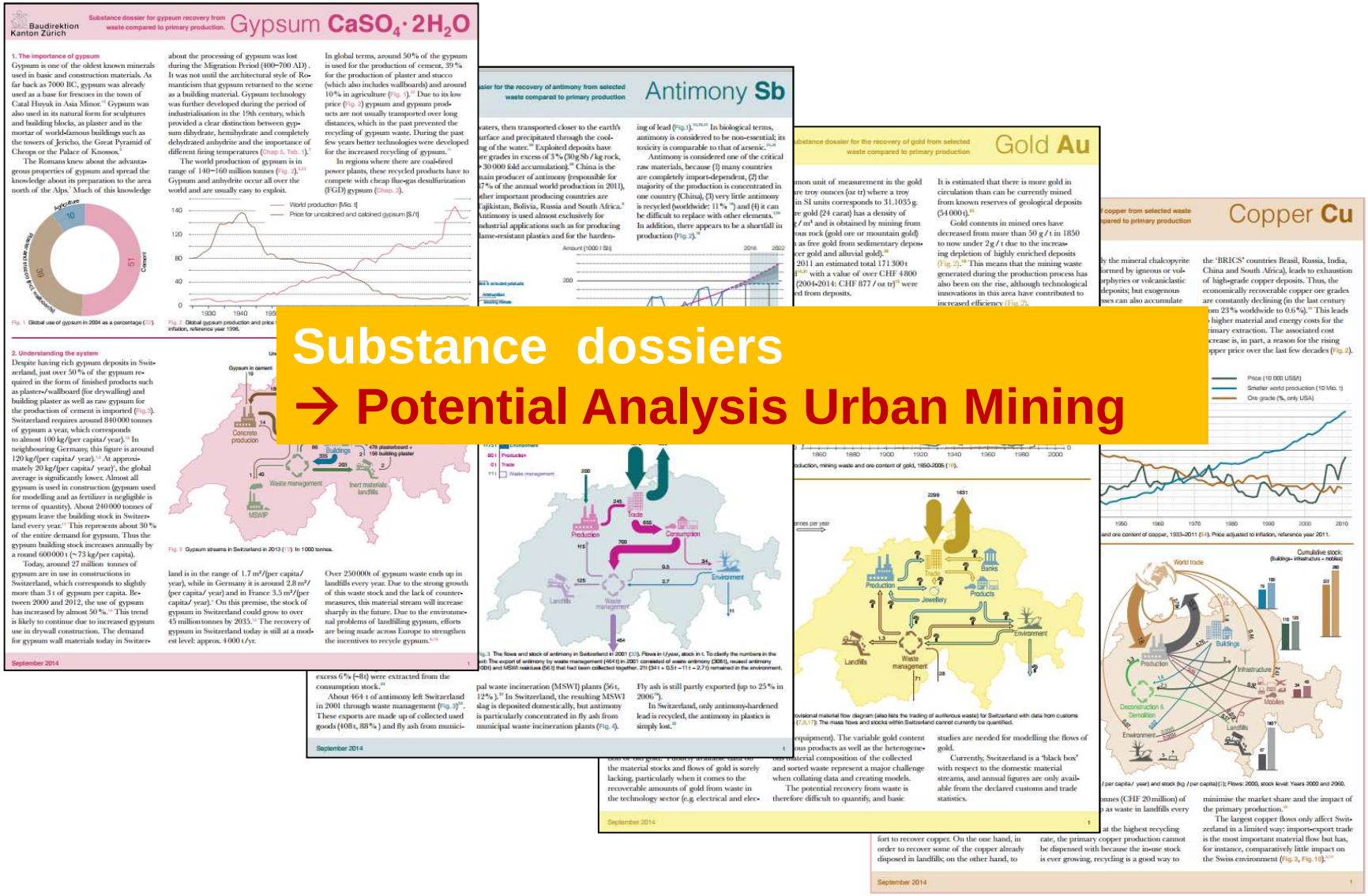
3) The metal industry determines the requirements to metallic raw materials (quality, inpurities) → non functional recycling.

4) Gravel Quarries and landfills provide suitable sinks for inorganic mineral waste with immobile substances (inertness, final sinks).

5) The capacity and condition of the (limited) natural sinks must be monitored, and early measures must be taken to prevent any capacity shortages.

Urban Mining ⟷ intact sinks

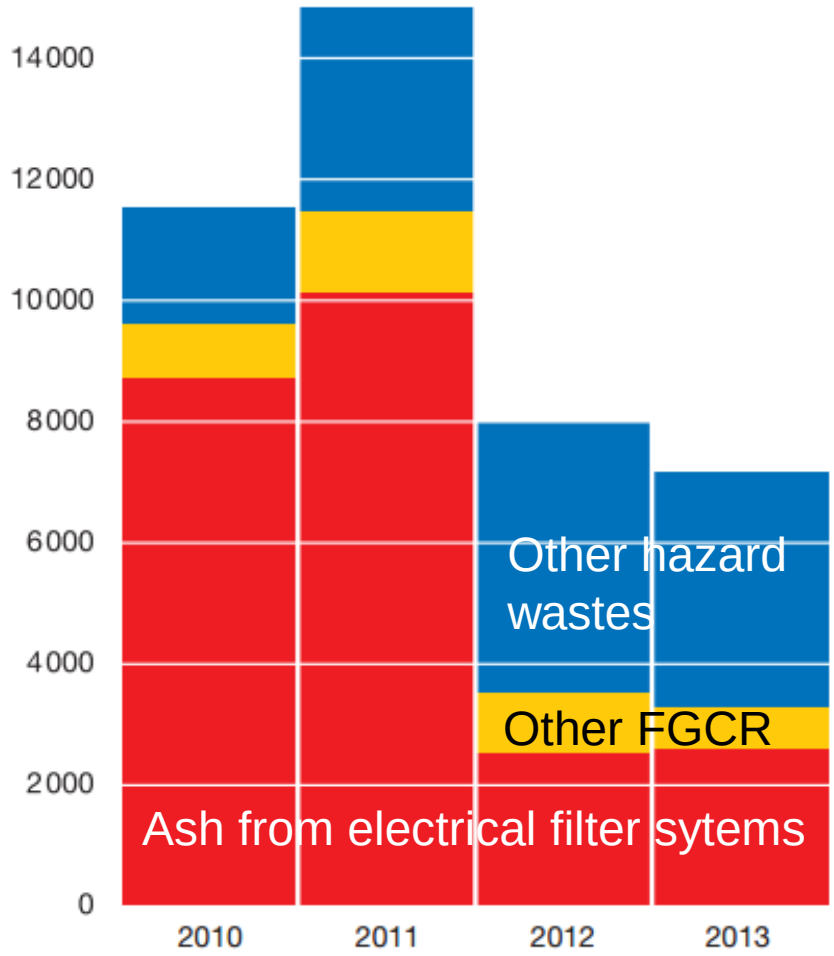
Future Activities in Urban Mining in Canton of Zurich



Substance dossiers

→ Potential Analysis Urban Mining

Challenge 2: Exported from Canton Zurich to underground facilities (tons)



FGCR =
Flue Gas Cleaning Residues

Resolving capacity shortages referring to Copper

Material	Proposed measures
WIP slag	Fixing a goal of 95% for the recovery of metallic copper from the WIP slag
WIP scrap	Support for activities to remove Cu from WIP scrap. The Centre for the Sustainable Ressource Management of Waste (ZAR) is currently conducting research and development to identify the potential for regaining Cu.

Conlusions: specific

1. Soil and partially also river sediments are receiving critical loads of copper
2. The release to the environment of copper by the waste management is not higher than by production/use and waste water management
3. Thermal treatment plants provide appropriate sinks for organic pollutants. 4% of PACs and 85% of DecaBDE were destroyed.
4. Substantial resource losses by i) exports of materials ii) depositing on quarries and landfills and iii) non functional usage
5. Measures to improve are described (see also «Action plan for Waste and Resource Management, 2015-18» of Canton Zurich and the new Swiss Ordinance on waste management).