

Abstract:

- The United Nations Environment Program has called for further research and regulatory activities on **mercury, cadmium and lead**.
- Environmental and health data suggest that international efforts should focus on **arsenic, chromium and selenium** as well.
- US EPA Toxic Release Inventory (TRI) data indicate that:
 - Total **metal releases** in the US are **increasing**
 - The **metals manufacturing** industry is now the **major source of airborne metals emissions**
 - In the metals industry, mercury emissions are low but **selenium emissions** are large and **increasing**
 - More data needed** in the metals industry on site-specific stack emissions and air pollution control efficiencies to **reduce metals emissions**.

Introduction:

- In February 2007, the United Nations Environment Program launched an initiative on mercury, lead and cadmium

- This poster provides:
- A comparison of the environmental and human hazard properties of metals
 - An analysis of metal emissions from the US Toxic Release Inventory (TRI)
 - Recommendations on data needs

Data Sources:

- United Nations Environment Program www.un.org
 - US EPA Toxicity Characteristic Leaching Procedure (TCLP) regulations
 - International Labor Organization www.ilo.org/public/english/protection/safework
 - US EPA Technology Transfer Network Air Toxics website (www.epa.gov/ttn/atw/toxsource/summary.html)
 - Indiana Relative Chemical Hazard Scores/Purdue University Clean Manufacturing Technology Institute <http://cobweb.ecn.purdue.edu/CMTI/IRCHS/>
 - Organization for Economic Cooperation and Development (OECD) reports www.oecd.org
 - US EPA Toxic Release Inventory (TRI) www.epa.gov
- Other websites:
- www.SeleniumWatch.org
 - www.agls.uidaho.edu/envirosci/resources.html
 - www.who.int/pcs
 - www.hazard.com/msds/index.html
 - www.europe.osha.eu.int/good_practices.risks/ds/oel.en

Comparison of Current Metal Emissions: Mercury, Cadmium, Lead and Selenium

John Heinze, Ph.D., Environmental Health Research Foundation, Chantilly, VA jheinze@ehrf.info
 Karen Hagelstein, Ph.D., CIH, TIMES Limited, Sheridan, WY aircaredoc@aol.com

Is the international focus on mercury, lead and cadmium too narrow?

Metals Environmental Hazard Ranking
 (EPA Hazardous Waste Toxicity Characteristic Leaching Procedure, TCLP)

Mercury = 0.2 mg/L
Selenium = 1.0 mg/L
 Cadmium = 1.0 mg/L
 Lead = 5.0 mg/L
Chromium = 5.0 mg/L
Arsenic = 5.0 mg/L



Metals Hazard Rankings

METALS	As	Cd	Cr (+3)	Pd	Hg	Se
OSHA PEL RANK (mg/m³)	2	1	6	3	4	5
CANCER	0.01	0.005	0.50	0.05	0.10	0.20

EPA Ambient Air Risk-Based Conc.

Relative Rank (mg/m³)	2	1	5	6	3	4
	4.1E-7	9.9E-7	5.5		3.1E-4	1.8E-2

EPA Hazardous Air Pollutant RANK

Total = 189 HAPS	17	13	5	42	4	126
Prioritized Chronic Inhalation Dose Response value (µg/m³)	0.03	0.02	0.1 (+6)	1.5	03	20

IFC Metal Mining Standards (mg/m³)

	0.002			0.05	0.05	0.20
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EPA Drinking Water MCL (mg/L)

	0.05	0.005	0.1	0.015	0.002	0.05
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Biological Exposure Indices

Steel Worker Overexposures	35 ug/L Urine	5 ug/g creat. Urine	25 ug/L Urine	30 ug/100 ml Blood	35 ug/g creat. Urine	25 ug/g creat. Urine
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Total Chemical Hazard Score (1-100 IRCHS)

	40.4	32.9	32.7	33.3	28.7	21.6
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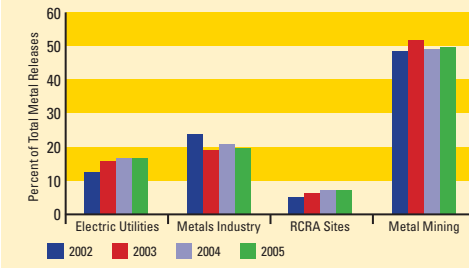
Ecosystem Bioaccumulation Lichen Studies (120)

	X	X	X	X	X	X
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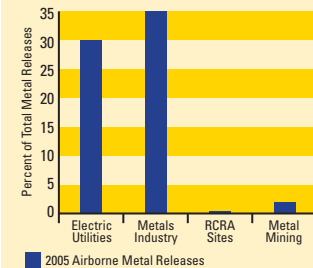
Metal Hazards Conclusion

- Combined environmental and health data suggest international efforts should focus on **arsenic, chromium and selenium** as well as **mercury, cadmium, and lead**
- For measuring metal exposures, international data, such as from OECD, on metals emissions is limited – US EPA Toxic Release Inventory (TRI) is best available data source

US Total Metal Releases Increasing EPA TRI Data



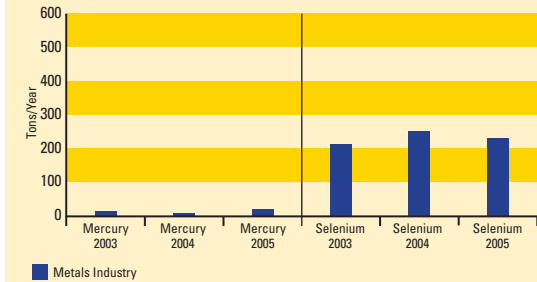
For Airborne Releases, Metals Industry is Largest Source



Point Sources Large – Controllable 2004 EPA TRI Data

METALS & METAL COMPOUNDS (POUNDS)	TOTAL ON/OFF SITE	TOTAL AIR FUGITIVE + POINT SOURCES	AIR PERCENT POINT SOURCES
Arsenic	167,620	329	85 %
Cadmium	1,170,000	3,813	77 %
Lead	31,600,000	440,000	72 %
Mercury	26,824	9,917	96 %
Selenium	501,087	35,679	97 %

Metals Industry – Selenium Releases Increasing and Larger than Mercury



Increase Likely Due to Increased Use of Selenium-Contaminated Metals

- Manganese metal widely used as hardening alloy in aluminum and steel industries
- Manganese metal made using selenium contains 400 to 1500 ppm selenium
- Selenium use as catalyst in manganese metal production increasing – 75% of the global manganese market

Emissions Control Data Limited

- No air emissions factors (EPA AP-42) for **arsenic, cadmium and selenium**
- Little available metals industry data on:
 - Site specific stack emission monitoring
 - Air pollution control efficiencies
- Particulate metals pollution control data from coal-powered utilities industry – Different for metals industry?

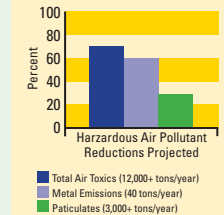
Controlling Particulate Metals Coal Power Utilities Data

- Effects of control technologies additive:
- Cyclone/Scrubber
 - Fabric Filters
 - Electrostatic Precipitation
 - Wet Flue Gas Desulfurization



Large Reductions Projected in Air Emissions from Secondary Aluminum Plants – Verification?

(EPA Area Source Regulations, 40 CFR Part 63, 2000)



Conclusions

- Research efforts should focus on **arsenic, chromium and selenium** as well as **mercury, cadmium, and lead**.
- US metals emissions are increasing and the metals industry is the major source of airborne metal emissions, which are from controllable point sources. **Mercury** emissions low but **selenium** emissions increasing.
- Recommended:
 - Metal industry metals monitoring of all wastes
 - Occupational & biological metal monitoring
 - Environmental audits