



# **Coal Ash Material Safety**

**A Health Risk-Based  
Evaluation of  
USGS Coal Ash Data from  
Five US Power Plants**



# Overview

- **Why is Coal Ash in the News?**

- TVA Kingston
- EPA Proposed Rulemaking
- ENGO Publications
- Current Legislation
- Is Coal Ash Toxic?

- **USGS Study**

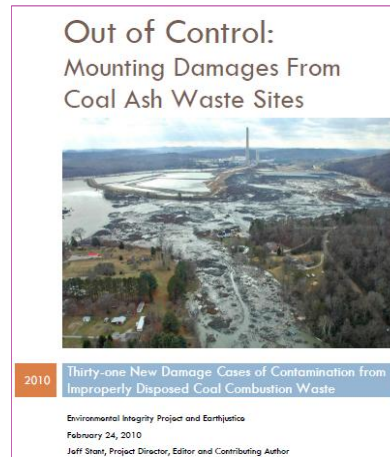
- Published a report that provides data for concentrations of metals and inorganics in **coal ash** from five power plants in across the US.

- **Objective of the ACAA/AECOM Study**

- To conduct a **human health risk-based evaluation** of the USGS coal ash data, using risk-based screening levels developed by the USEPA that are protective of a child's exposure to residential soils.

- **Risk Assessment**

- **Study Methods, Results, Conclusions**



### Toxic coal ash piling up in ponds in 32 states

Posted 1/9/2009 8:57 PM

By Dina Cappiello, Associated Press

- Lisa JN Bradley, PhD, DABT
- PhD in Toxicology from the Massachusetts Institute of Technology (MIT)
- Diplomate of the American Board of Toxicology
- Vice President
- 20 years of experience as toxicologist and risk assessor
- ACAA Executive Committee Member

# USGS Data on Coal Ash Constituent Concentrations



## Geochemical Database of Feed Coal and Coal Combustion Products (CCPs) from Five Power Plants in the United States

By Ronald H. Affolter,<sup>1</sup> Steve Groves,<sup>1</sup> William J. Betterton,<sup>1</sup> William Benzel,<sup>1</sup> Kelly L. Conrad,<sup>1</sup> Sharon M. Swanson,<sup>2</sup> Leslie F. Ruppert,<sup>2</sup> James G. Clough,<sup>2</sup> Harvey E. Belkin,<sup>2</sup> Allan Kolker,<sup>2</sup> and James C. Hower<sup>2</sup>



Pamphlet to accompany  
Data Series 635

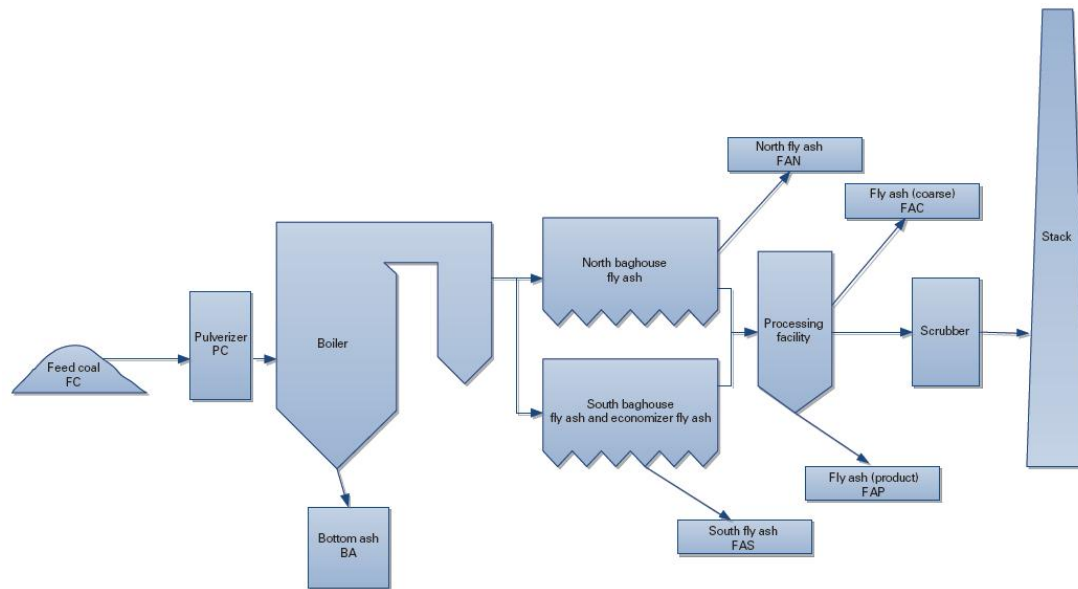
U.S. Department of the Interior  
U.S. Geological Survey

- **Geochemical Database of Feed Coal and Coal Combustion Products (CCPs) from Five Power Plants in the United States.** Data Series 635. US Geological Survey (USGS). Available at: <http://pubs.usgs.gov/ds/635/>

State	Coal Source	Coal Ash	# samples
Alaska	Nenana Coal Province	Fly Ash/Bottom Ash	19
Indiana	Illinois	Fly Ash	13
New Mexico	San Juan	Fly Ash Product Bottom Ash	19 18
Ohio	Appalachian	Fly Ash Bottom Ash	13 15
Wyoming	Powder River	Fly Ash Bottom Ash	13 15

# Dataset Selection

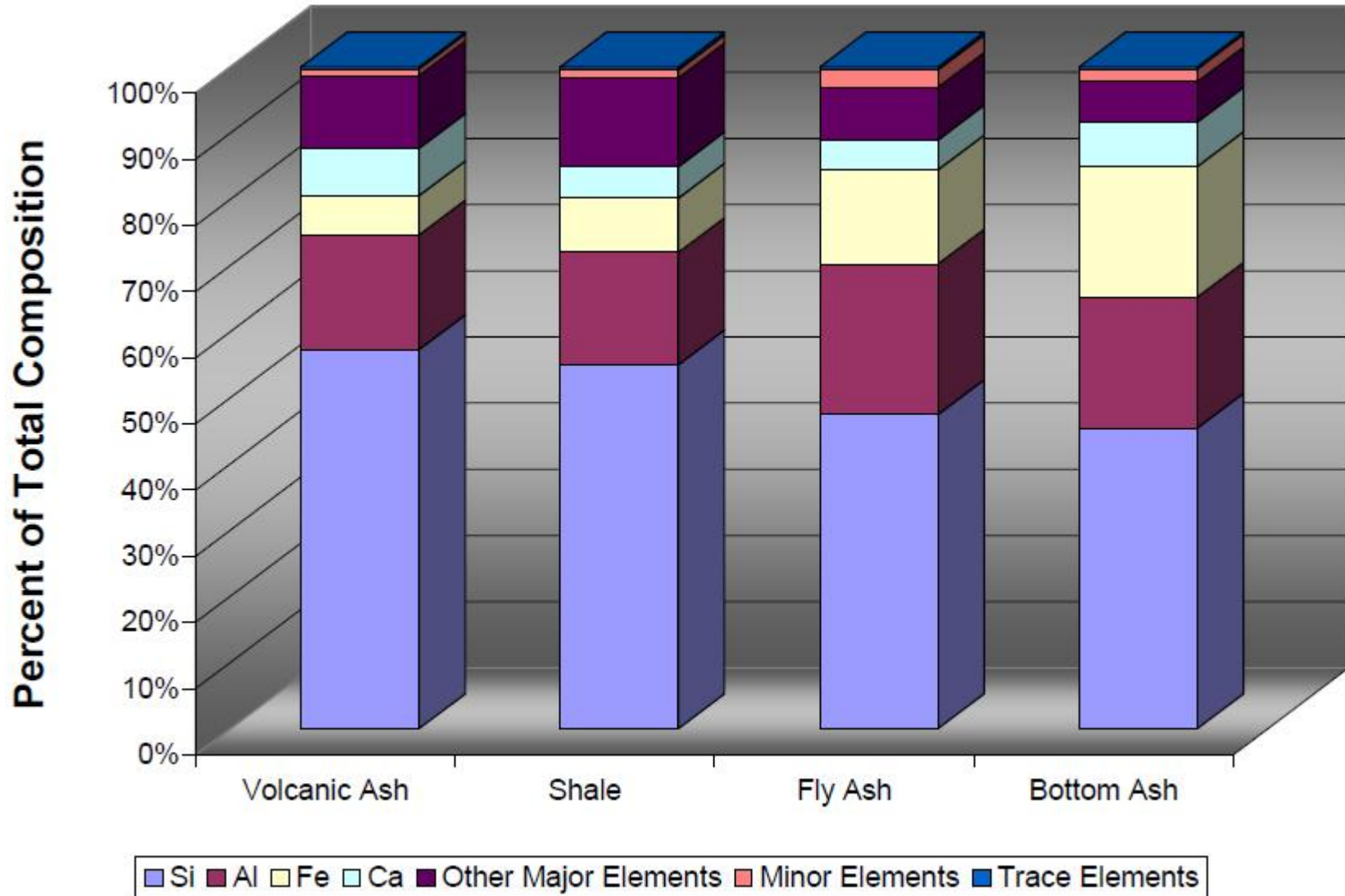
New Mexico	San Juan	Bottom Ash	X
		Fly Ash North	
		Fly Ash South	
		Fly Ash Coarse	
		Fly Ash (Product)	X



From the New Mexico Power Plant schematic, it was concluded that the fly ash north and fly ash south materials represent intermediate steps in fly ash production. It is assumed that the material labeled fly ash (product) and bottom ash represent materials that could be beneficially used.



# What are in CCPs?



Source  
EPRI, 2010. Comparison of Coal Combustion Products to Other Common Materials – Chemical Characteristics. Report No. 1020556. Available for download at [www.epri.com](http://www.epri.com)

# Trace Elements

- **What are trace elements?**

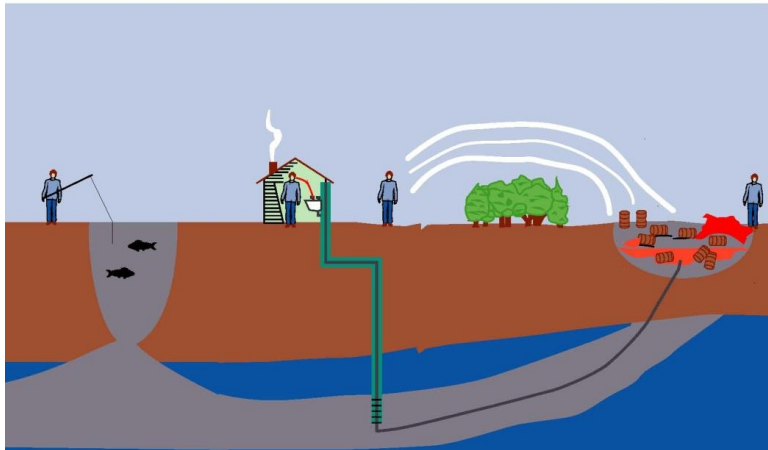
- Sb – Antimony
- As – Arsenic
- Ba – Barium
- Be – Beryllium
- Cd – Cadmium
- Cr – Chromium
- Co – Cobalt
- Cu – Copper
- Pb – Lead
- Li – Lithium
- Mn – Manganese
- Hg – Mercury
- Mo – Molybdenum
- Ni – Nickel
- Se – Selenium
- Sr – Strontium
- Tl – Thallium
- U – Uranium
- V – Vanadium
- Zn – Zinc

- **Why are they called trace elements?**

- They are present in concentrations of milligram per kilogram (mg/kg), equivalent to:
  - One part per million (ppm):
    - 1 penny in a stack of \$10,000
    - 1 second in 11.5 days
    - 1 inch in 15.8 miles



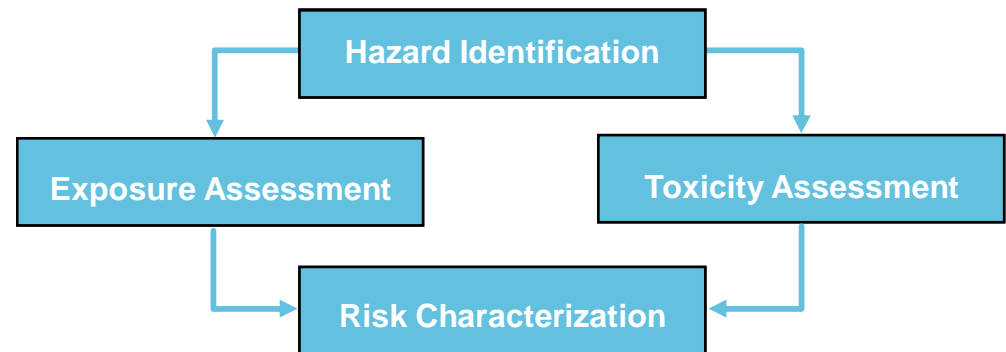
# Risk Assessment



“All substances are poisons;  
there is none which is not a  
poison.

The right dose differentiates a  
poison from a remedy.”

*Paracelsus, 1500s*



$$\text{Risk} = \text{Exposure} \times \text{Toxicity}$$

If there is no exposure,  
there is no risk

# How do we evaluate concentrations of trace elements in soil?

## USEPA Regional Screening Levels (RSLs):

- Screening levels are calculated based on a **residential** soil exposure scenario: assumes that a child and adult are exposed to constituents in soil on a daily basis by incidental ingestion, dermal contact, and inhalation of dusts.
- In essence, we are assuming that a house is built on top of a coal ash landfill and instead of being exposed to dirt or soil, **all contact is with coal ash.**
- USEPA's screening levels evaluate both potential carcinogenic and noncarcinogenic effects. For noncancer effects, the screening levels are based only a **child's exposure to soil**, as a child is smaller than an adult and is assumed to have a higher contact with soil.
- As noted by USEPA, the screening levels (RSLs) are considered by the Agency to be **protective for humans (including sensitive groups) over a lifetime**, and
- Generally, at sites where concentrations fall below the RSLs, no further action or study is warranted.



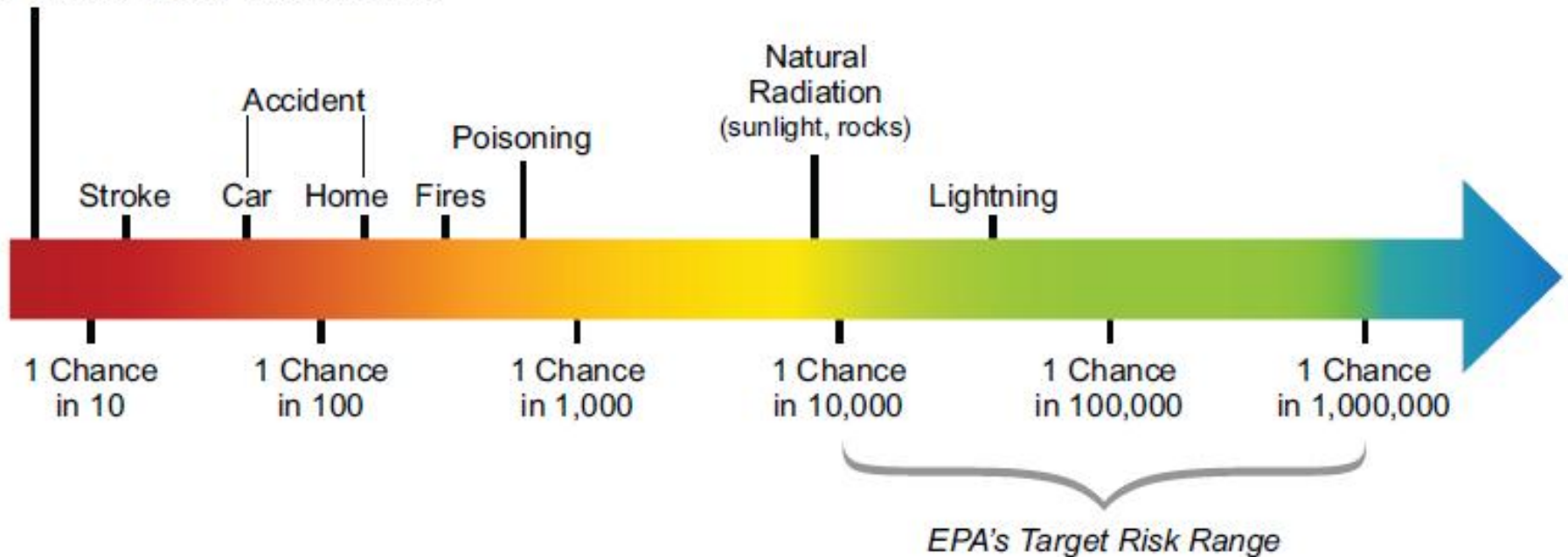
RSLs: USEPA. May 2012. Values for residential soil. [http://www.epa.gov/reg3hwmd/risk/human/rb-concentration\\_table/index.htm](http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm)



# Risks in Perspective

## Range of Lifetime Risk of Fatality Compared with EPA's Target Risk Range

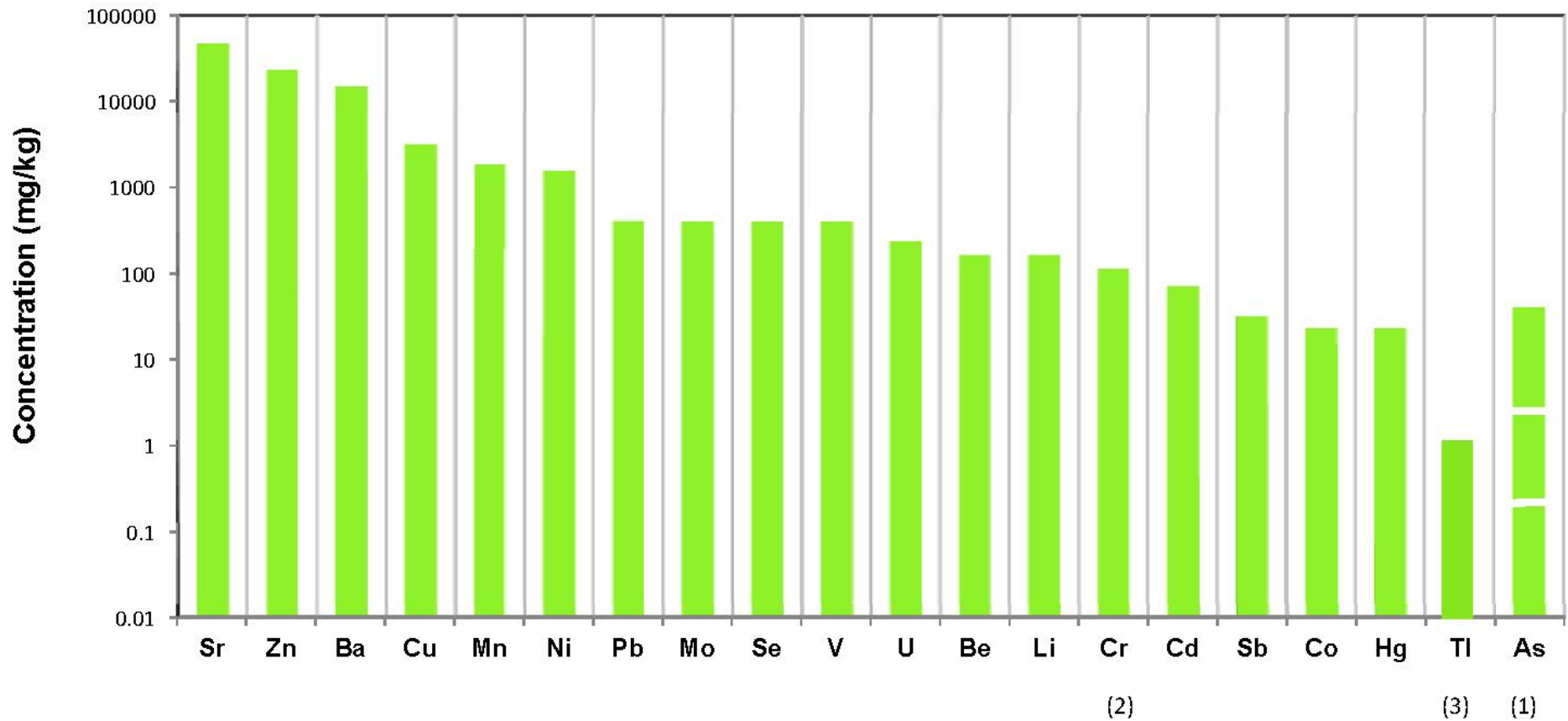
Current Lifetime Risk in the U.S. of Developing Cancer (ACS) is 1 Chance in 2 to 1 Chance in 3



### Sources

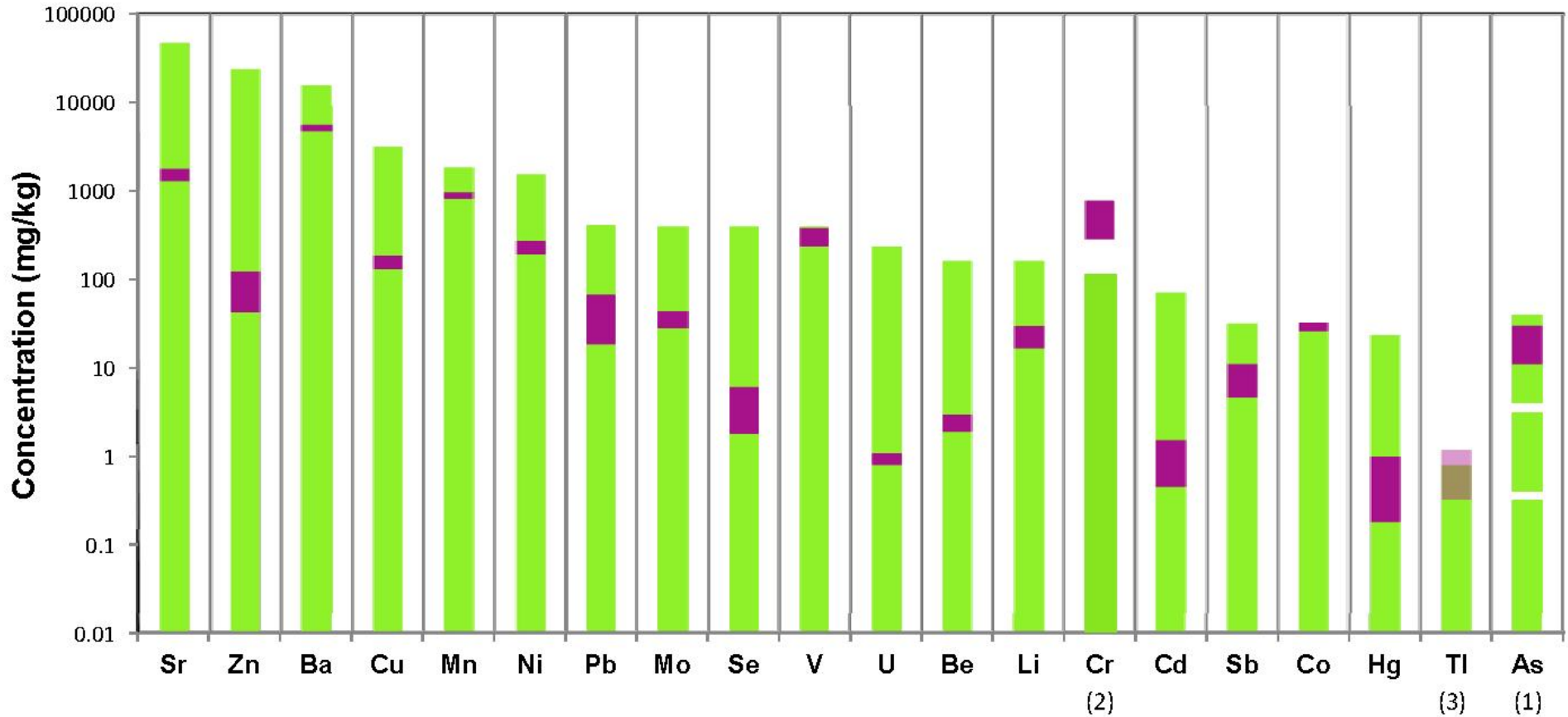
- Adapted from U.S. EPA 450/3-90-022, Mar. 1991, [http://www.epa.gov/air/oaqps/air\\_risc/3\\_90\\_022.html](http://www.epa.gov/air/oaqps/air_risc/3_90_022.html) (1996)
- American Cancer Society. *Cancer Facts and Figures*. Updated Annually. <http://www.cancer.org/Research/CancerFactsFigures/index>

# USEPA Regional Screening Levels for Residential Soils



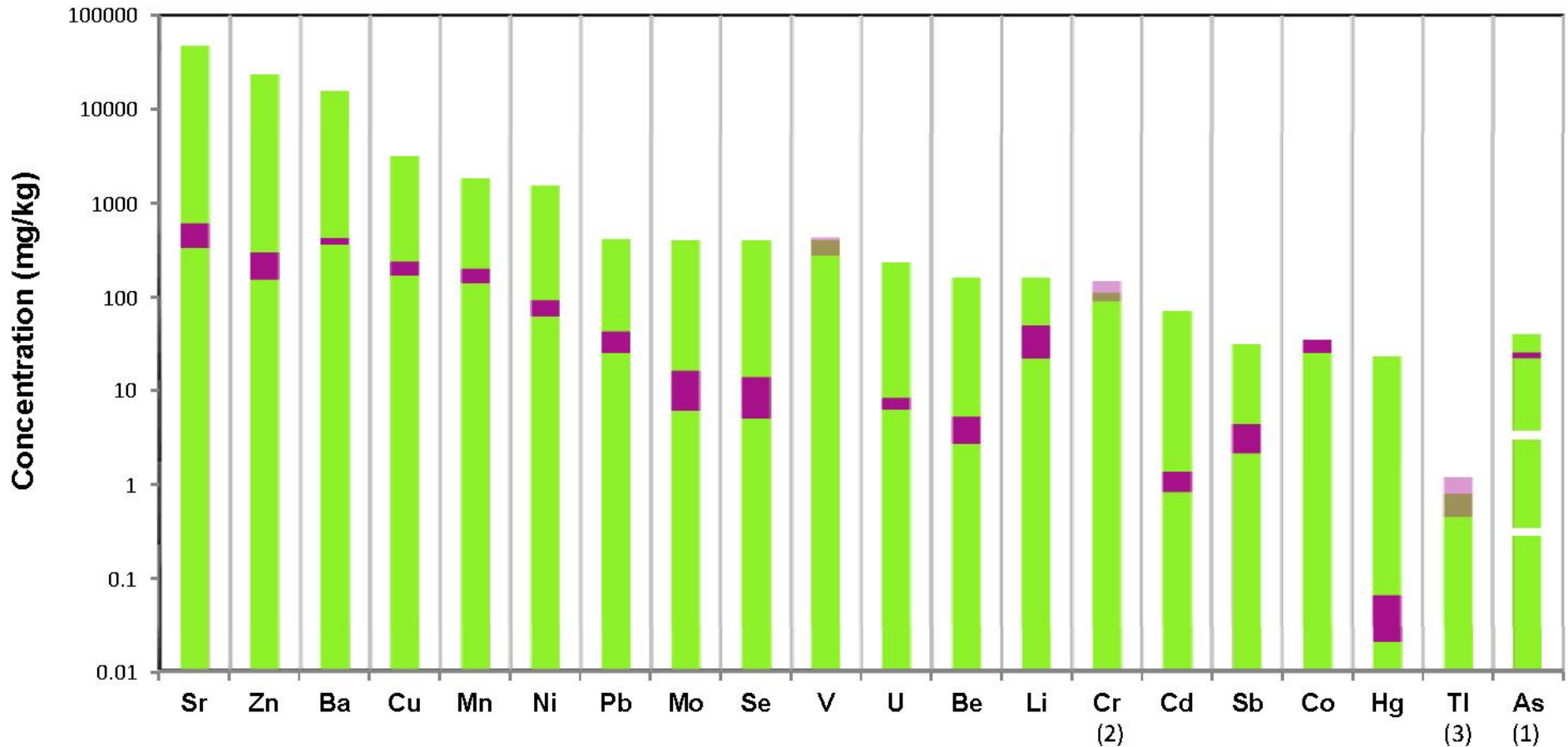
RSLs: USEPA. May 2012. Values for residential soil. [http://www.epa.gov/reg3hwmd/risk/human/rb-concentration\\_table/index.htm](http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm)

## Comparison of USGS Database Constituent Concentrations in Fly/Bottom Ash at the Alaska Coal Power Plant to the USEPA RSLs for Residential Soils



RSLs: USEPA. May 2012. Values for residential soil. [http://www.epa.gov/reg3hwmd/risk/human/rb-concentration\\_table/index.htm](http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm)  
 Ash Data: USGS. 2011. Data Series 635. Available at: <http://pubs.usgs.gov/ds/635/om>

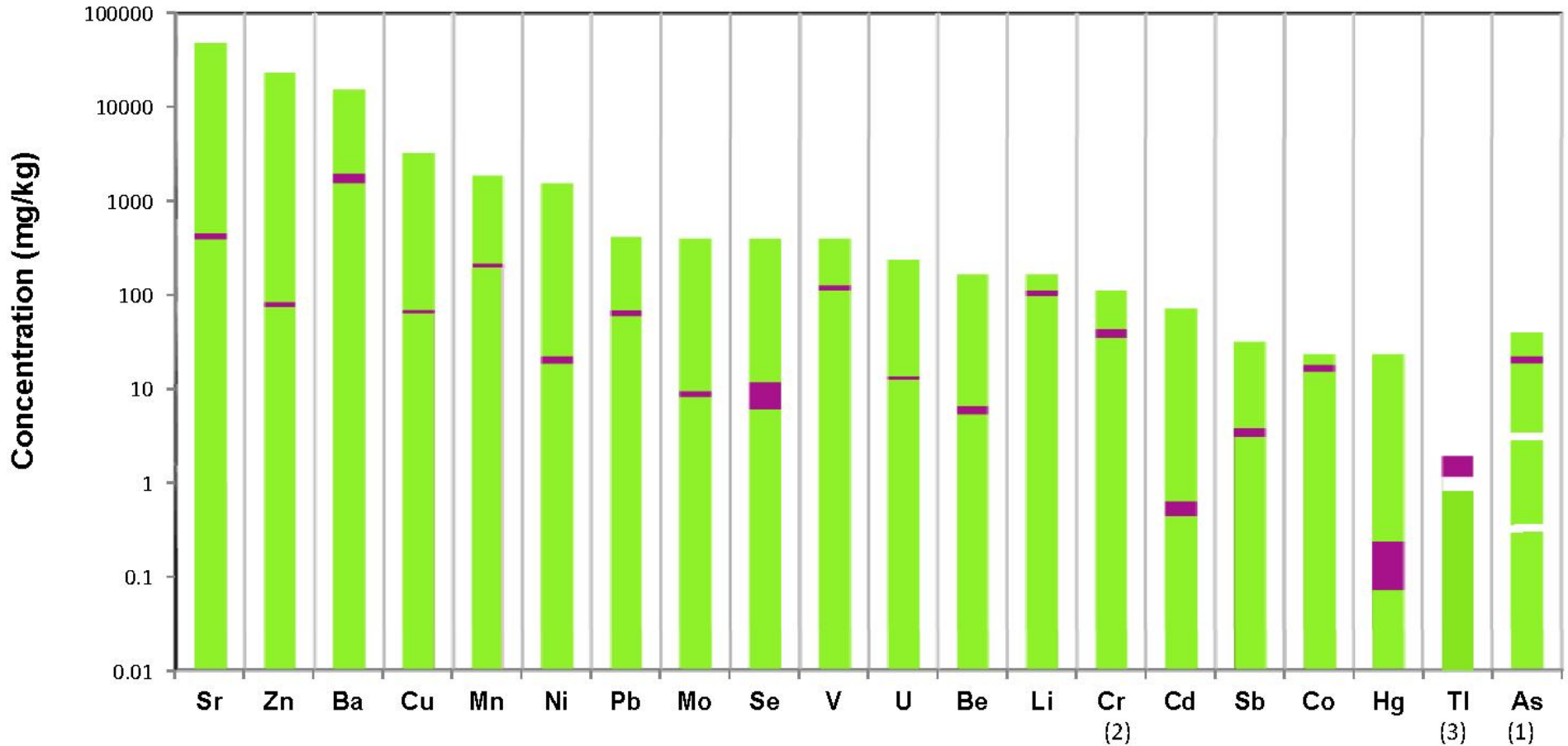
## Comparison of USGS Database Constituent Concentrations in All Fly Ash at the Indiana Coal Power Plant to the USEPA RSLs for Residential Soils



RSLs: USEPA. May 2012. Values for residential soil. [http://www.epa.gov/reg3hwmd/risk/human/rb-concentration\\_table/index.htm](http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm)  
 Ash Data: USGS. 2011. Data Series 635. Available at: <http://pubs.usgs.gov/ds/635/om>

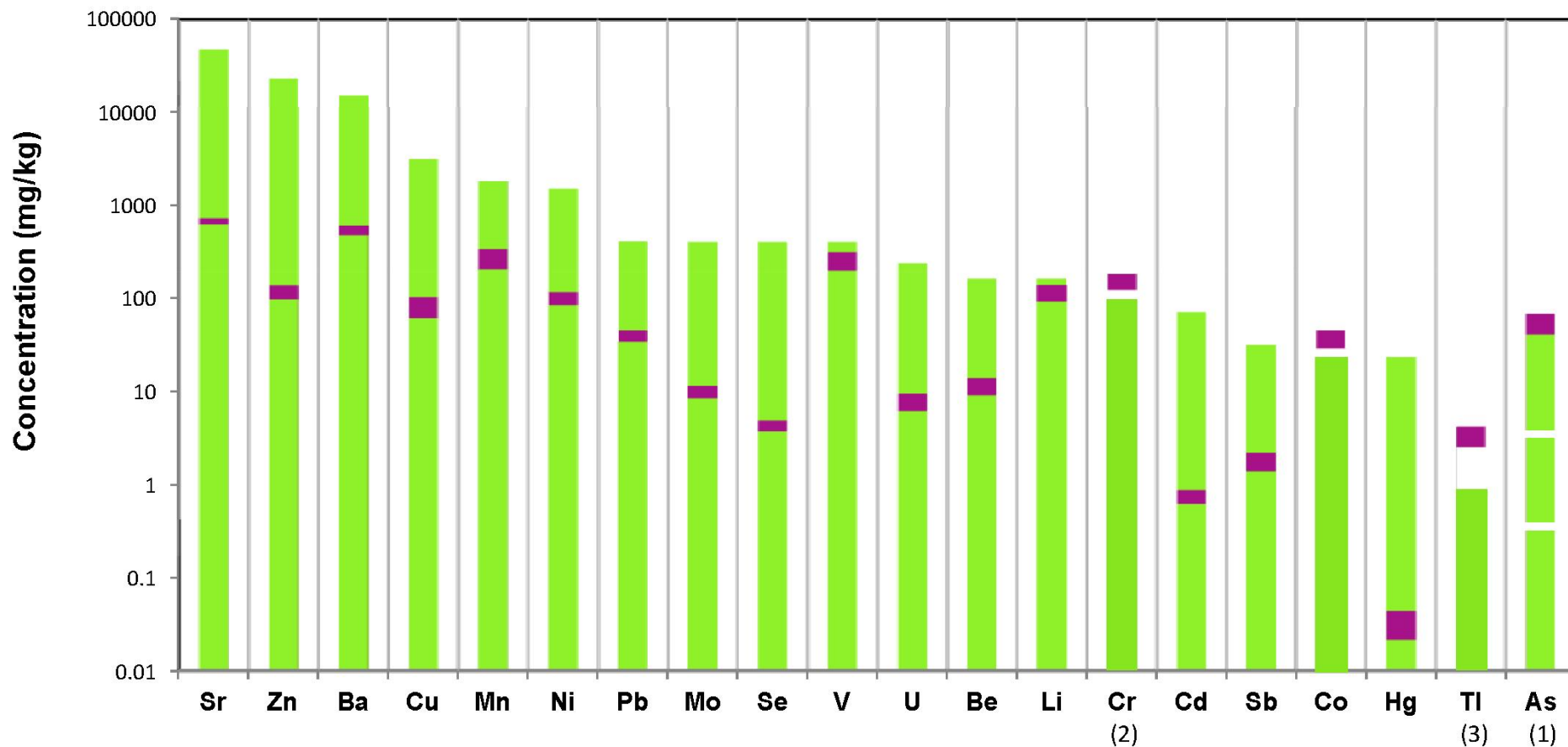


# Comparison of USGS Database Constituent Concentrations in Fly Ash Product at the New Mexico Coal Power Plant to the USEPA RSLs for Residential Soils



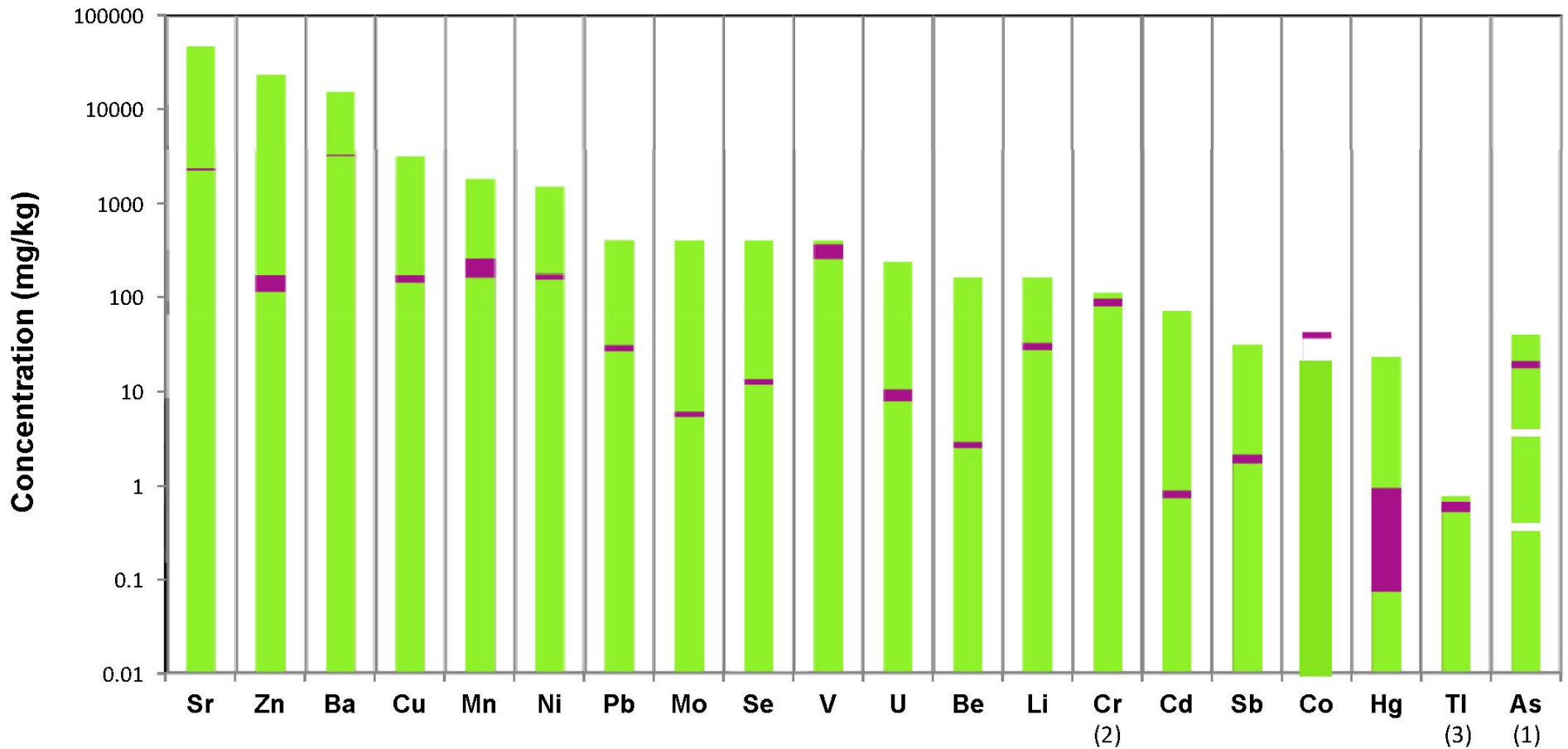
RSLs: USEPA. May 2012. Values for residential soil. [http://www.epa.gov/reg3hwmd/risk/human/rb-concentration\\_table/index.htm](http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm)  
 Ash Data: USGS. 2011. Data Series 635. Available at: <http://pubs.usgs.gov/ds/635/om>

## Comparison of USGS Database Constituent Concentrations in Fly Ash at the Ohio Coal Power Plant to the USEPA RSLs for Residential Soils



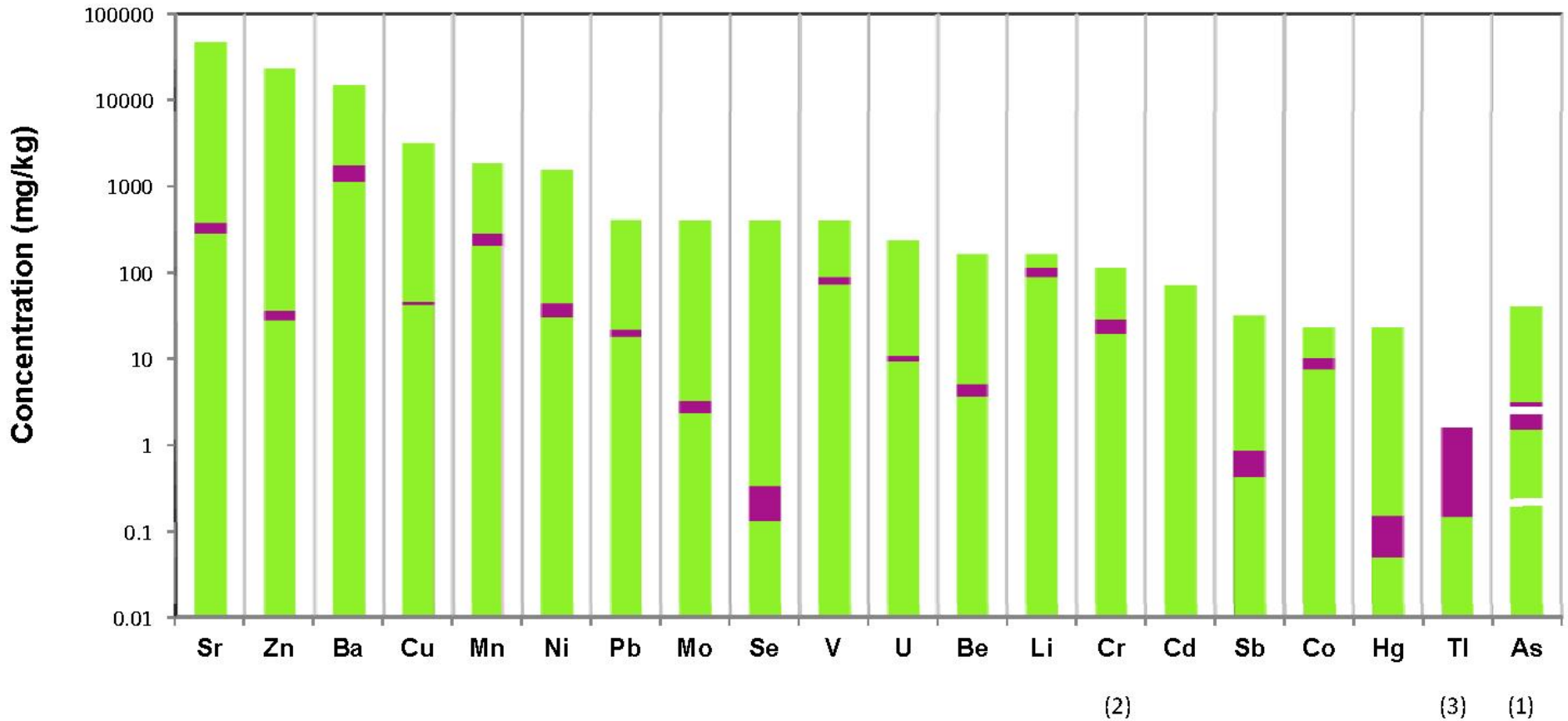
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 Ash Data: USGS. 2011. Data Series 635. Available at: <http://pubs.usgs.gov/ds/635/om>

## Comparison of USGS Database Constituent Concentrations in Fly Ash at the Wyoming Coal Power Plant to the USEPA RSLs for Residential Soils



RSLs: USEPA. May 2012. Values for residential soil. [http://www.epa.gov/reg3hwmd/risk/human/rb-concentration\\_table/index.htm](http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm)  
 Ash Data: USGS. 2011. Data Series 635. Available at: <http://pubs.usgs.gov/ds/635/om>

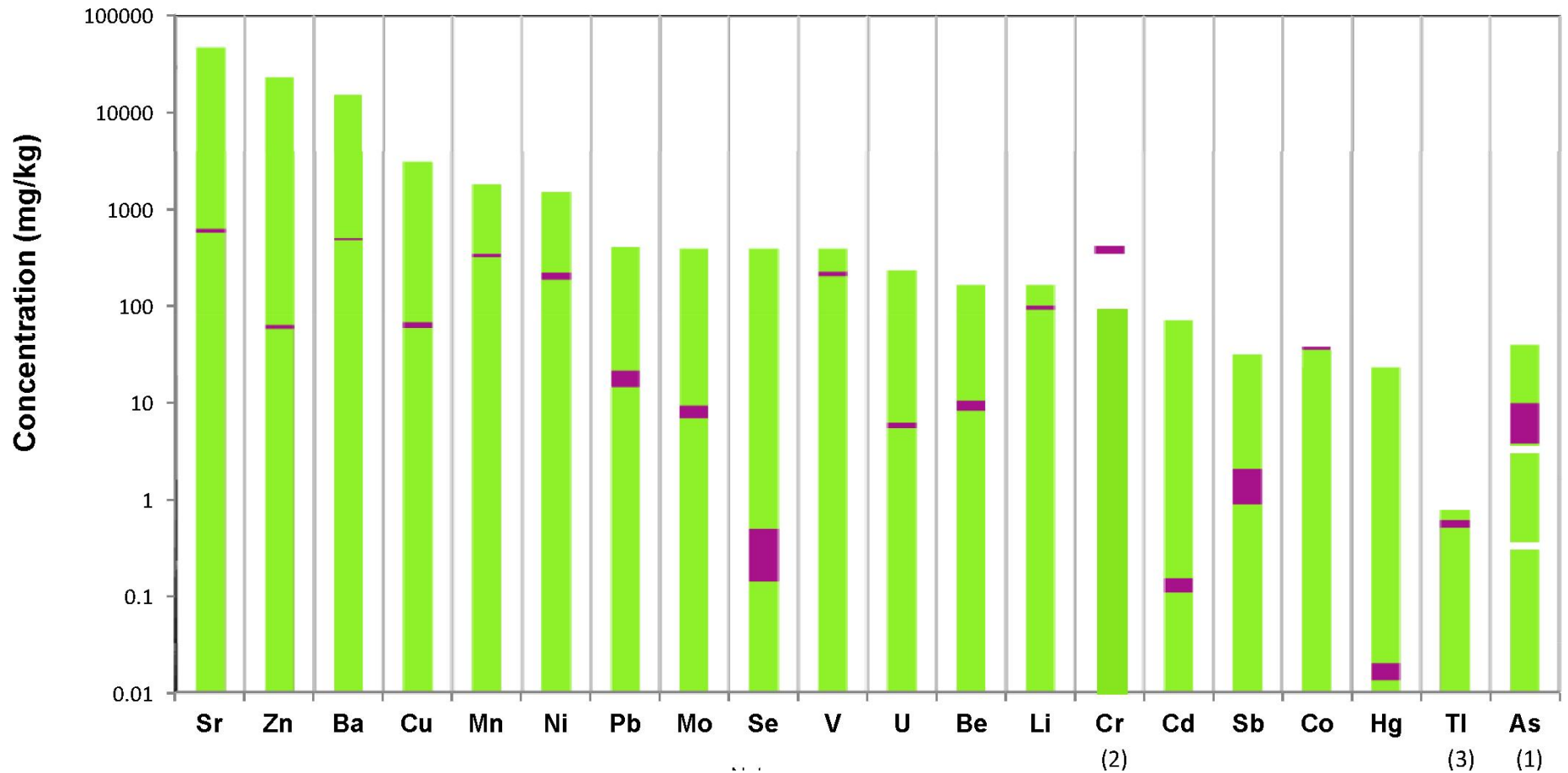
## Comparison of USGS Database Constituent Concentrations in Bottom Ash at the New Mexico Coal Power Plant to the USEPA RSLs for Residential Soils



RSLs: USEPA. May 2012. Values for residential soil. [http://www.epa.gov/reg3hwmd/risk/human/rb-concentration\\_table/index.htm](http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm)  
 Ash Data: USGS. 2011. Data Series 635. Available at: <http://pubs.usgs.gov/ds/635/om>

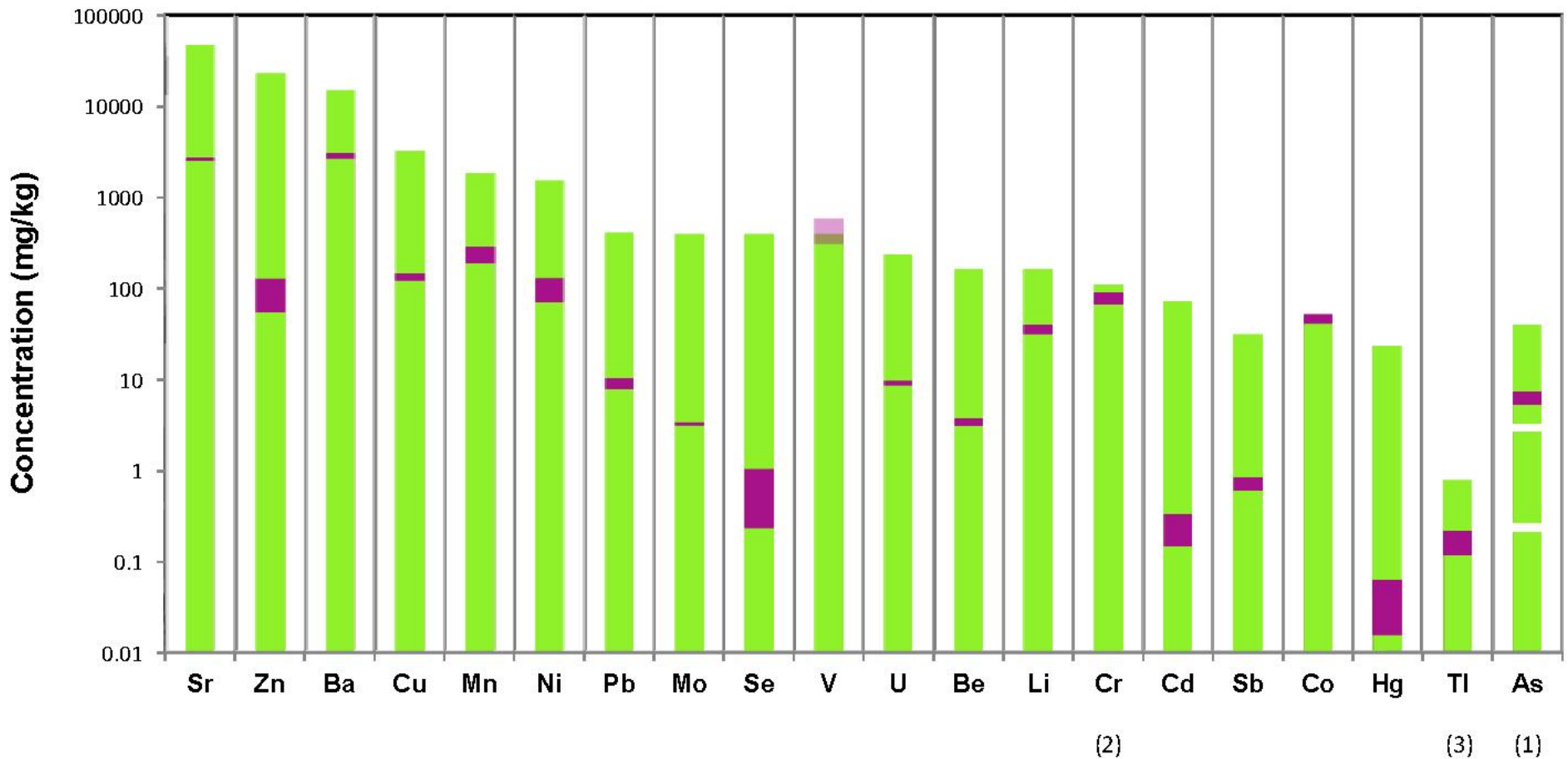


# Comparison of USGS Database Constituent Concentrations in Bottom Ash at the Ohio Coal Power Plant to the USEPA RSLs for Residential Soils



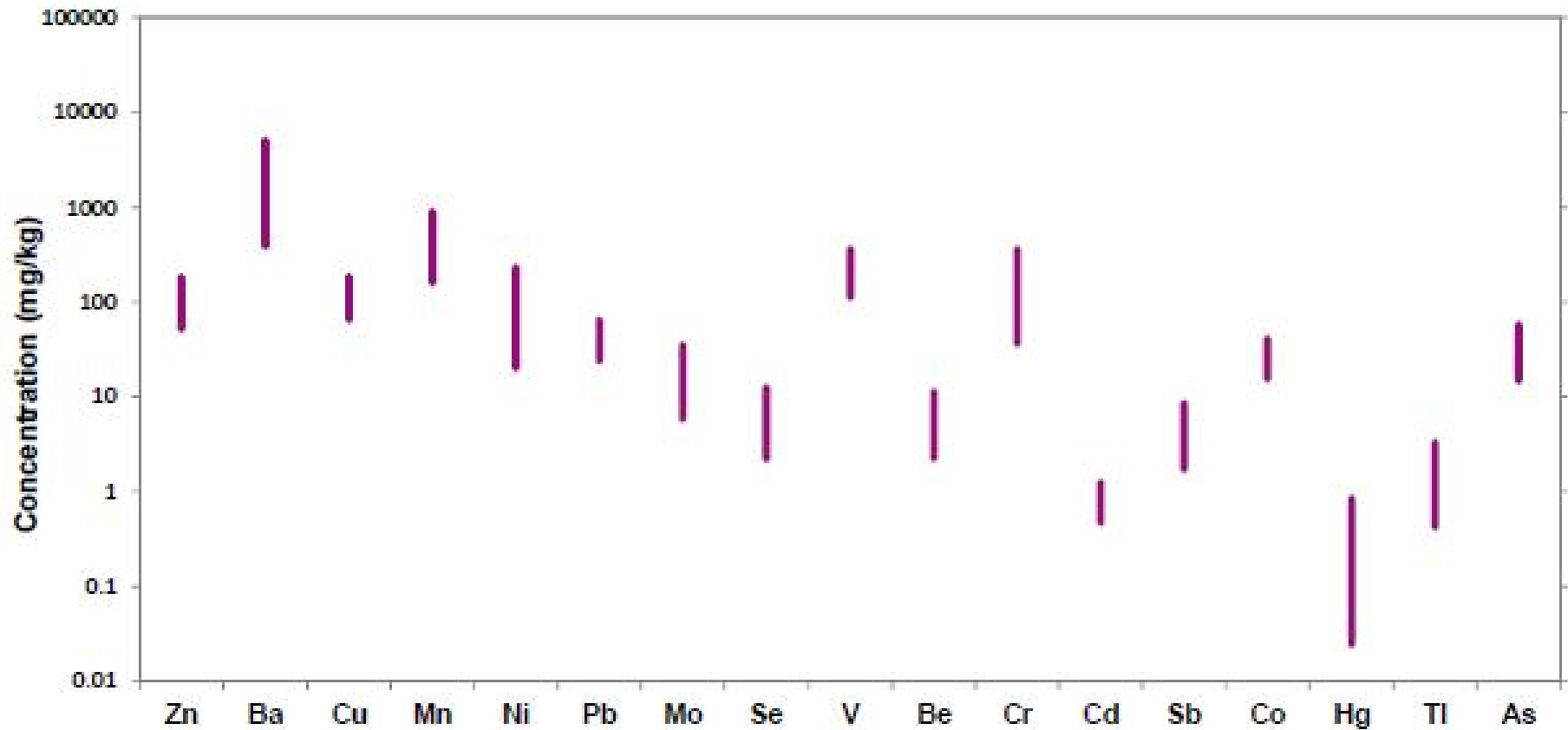
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 Ash Data: USGS. 2011. Data Series 635. Available at: <http://pubs.usgs.gov/ds/635/om>

## Comparison of USGS Database Constituent Concentrations in Bottom Ash at the Wyoming Coal Power Plant to the USEPA RSLs for Residential Soils



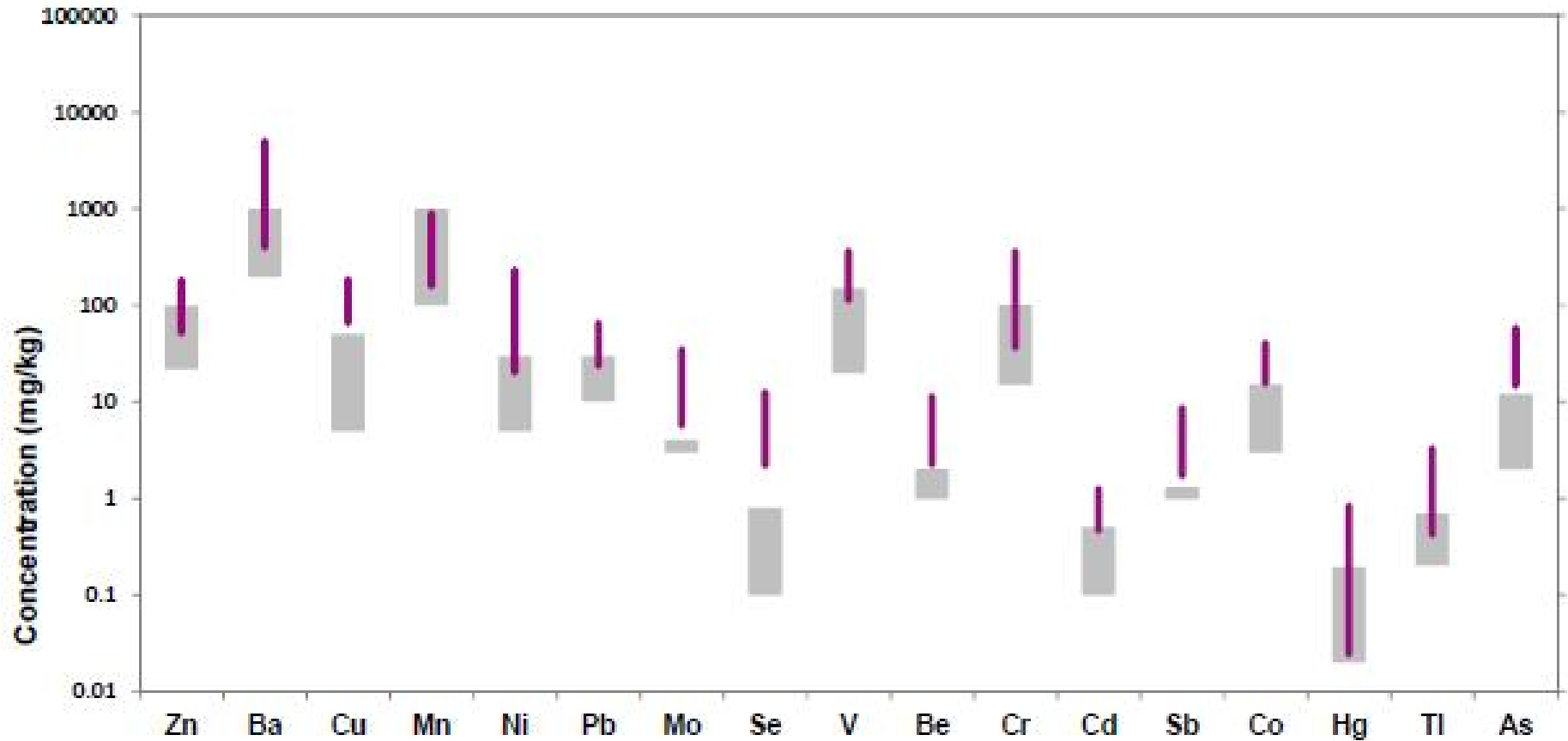
RSLs: USEPA. May 2012. Values for residential soil. [http://www.epa.gov/reg3hwmd/risk/human/rb-concentration\\_table/index.htm](http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm)  
 Ash Data: USGS. 2011. Data Series 635. Available at: <http://pubs.usgs.gov/ds/635/om>

# Fly Ash: 10<sup>th</sup>-90<sup>th</sup> Percentiles USGS Data Combined



Ash Data: USGS. 2011. Data Series 635. Available at: <http://pubs.usgs.gov/ds/635/om>

# Fly Ash and Background Soils in US – 10<sup>th</sup>-90<sup>th</sup> Percentiles

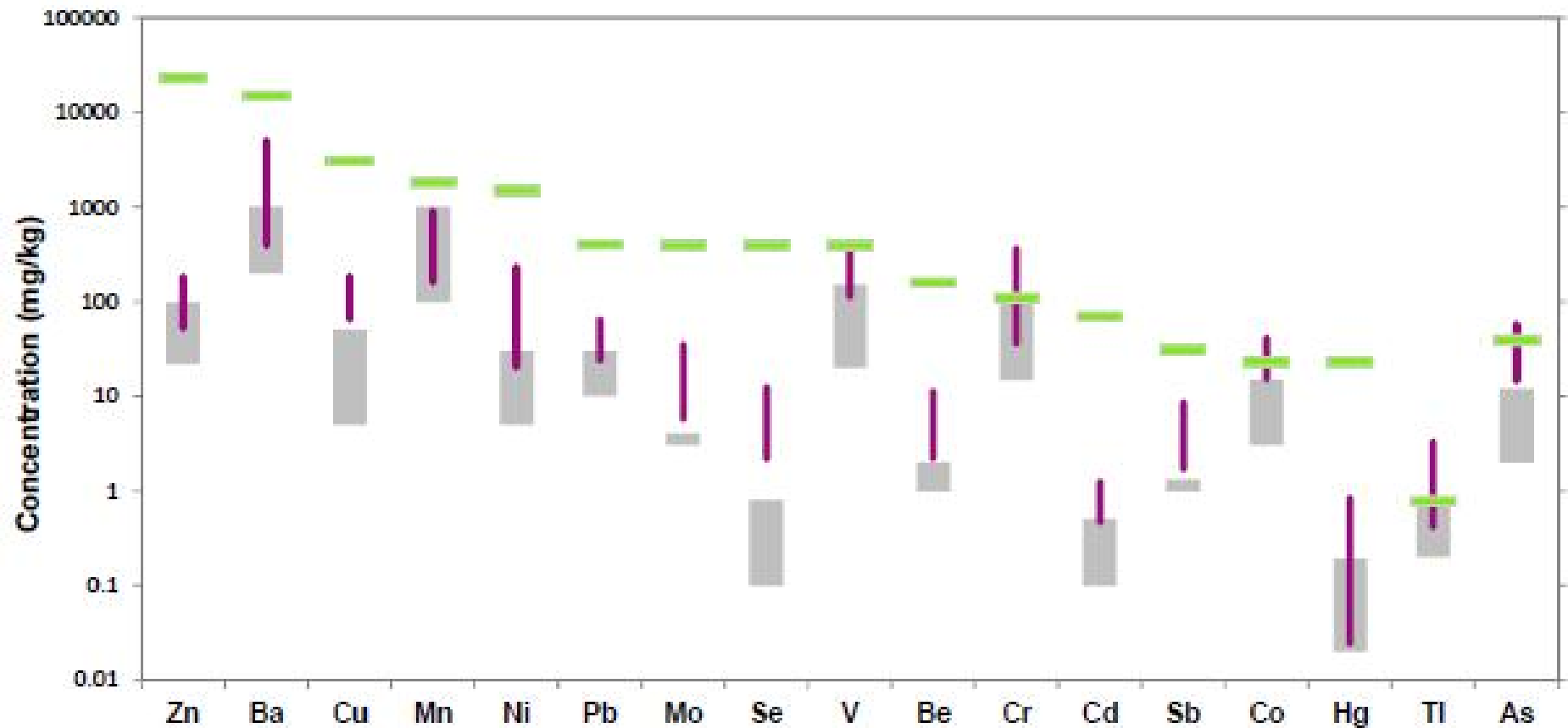


Background Soils: EPRI. 2010. Report No. 1020556. Available for download at: [www.epri.com](http://www.epri.com)

Ash Data: USGS. 2011. Data Series 635. Available at: <http://pubs.usgs.gov/ds/635/om>

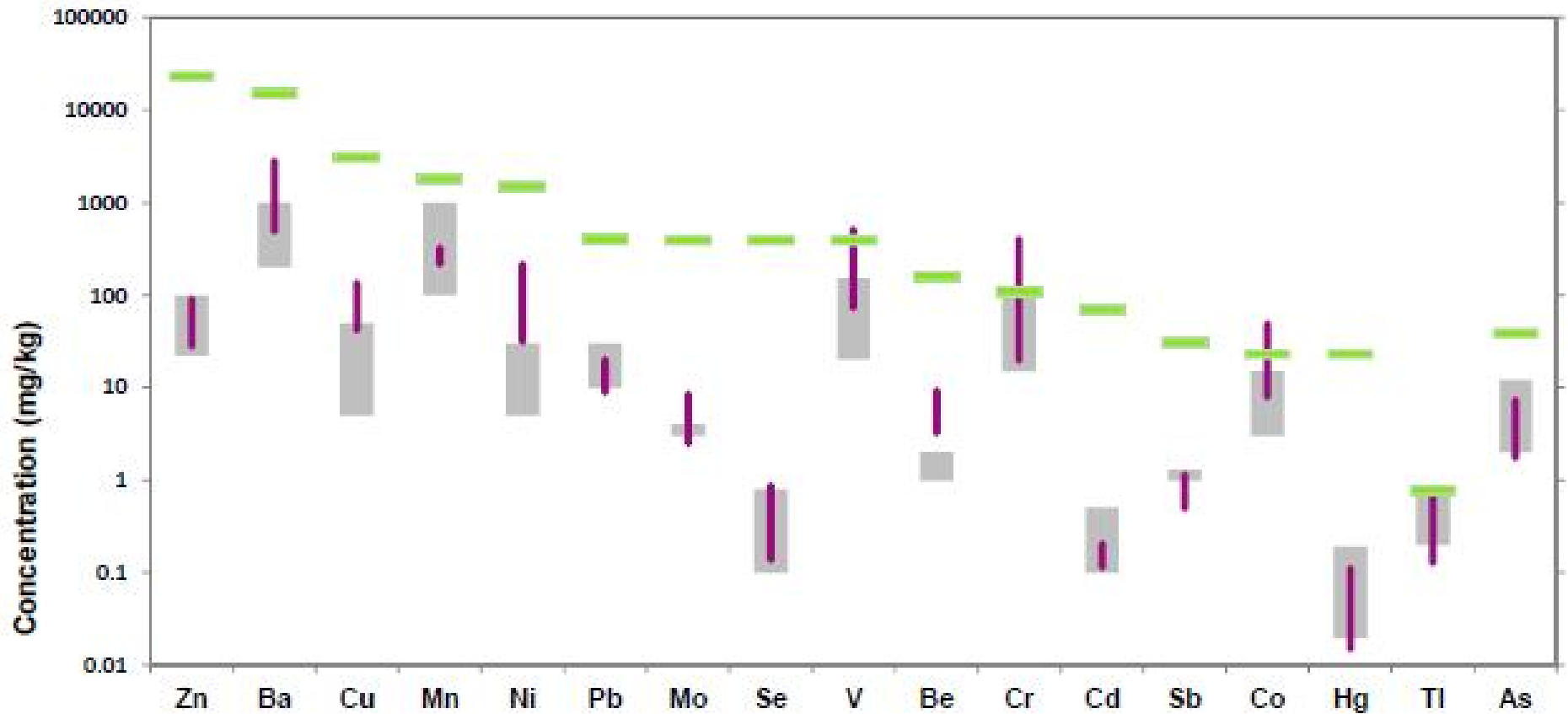


# Comparison of 10<sup>th</sup>-90<sup>th</sup> percentiles in Fly Ash and Background Levels in US Soils to the USEPA RSLs for Residential Soils



RSLs: USEPA. May 2012. Values for residential soil. [http://www.epa.gov/reg3hwmd/risk/human/rb-concentration\\_table/index.htm](http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm)  
 Background Soils: EPRI. 2010. Report No. 1020556. Available for download at: [www.epri.com](http://www.epri.com)  
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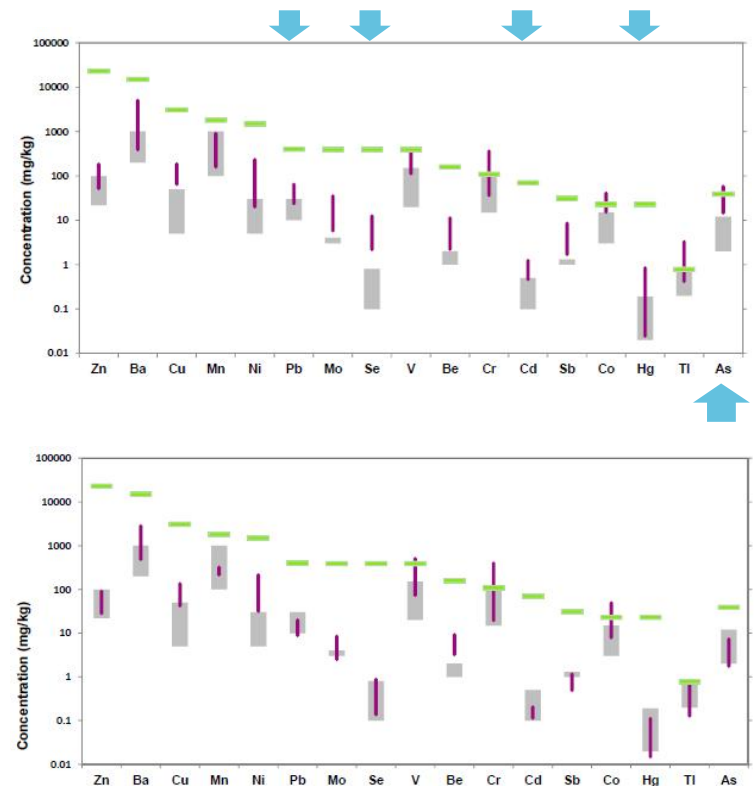
# Comparison of 10<sup>th</sup>-90<sup>th</sup> percentiles in Bottom Ash and Background Levels in US Soils to the USEPA RSLs for Residential Soils



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 Background Soils: EPRI. 2010. Report No. 1020556. Available for download at: [www.epri.com](http://www.epri.com)  
 Ash Data: USGS. 2011. Data Series 635. Available at: <http://pubs.usgs.gov/ds/635/om>

## Discussion and Context

- Environmental groups continually single out the toxic effects of the following, without discussing concentrations, or putting them into an exposure context:
  - Arsenic, lead, mercury, cadmium, chromium and selenium
- Concentrations of lead, mercury, cadmium, and selenium in both fly ash and bottom ash are consistently well below the residential soil screening levels.
- In fact, all concentrations of 15 of the 20 elements are below residential soils screening levels.
- Only the fly ash data for the Ohio plant has an upper-bound concentration of arsenic that is slightly above USEPA's risk range (2 in 10,000 vs. 1 in 10,000).



## Summary

- The results indicate that with few exceptions constituent concentrations in **coal ash are below screening levels for residential soils**, and are similar in concentration to background US soils.
- Thus, not only does coal ash not qualify as a hazardous substance from a regulatory perspective, **it would not be classified as hazardous on a human health risk basis.**
- Because exposure to coal ash used in **beneficial applications**, such as concrete, road base, or structural fill would be much lower than a residential scenario, these uses would also not pose a direct contact risk to human health.
- Report available at:
  - [http://www.acaa-usa.org/associations/8003/files/ACAA\\_CoalAshMaterialsafety\\_June2012.pdf](http://www.acaa-usa.org/associations/8003/files/ACAA_CoalAshMaterialsafety_June2012.pdf)
- Article summarizing the study in Ash at Work:
  - <http://www.acaa-usa.org/associations/8003/files/ASH01-2012.pdf>





## I Think We Hit A Nerve.....



# CHERRY PICKING

If you can't debate your opponents on the substance of the issue, crush them on the minor details.

- Earth Justice Blog (prior to report publication):
- The association's junk science report severely distorts the facts.
- The report ignores important routes of exposure.
- The report invents health-based screening levels to replace the EPA values it doesn't like.
- ACAA cherry-picked fly ash data containing lower levels of arsenic to fit its premise.
- An intellectually honest report would show that coal ash contains many toxic pollutants at concentrations much greater than applicable health-based screening levels and the levels found in most soils.