






## Coal Ash Material Safety

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

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### Study Objective

- In the **public debate** on regulatory and legislative fronts about coal ash, news stories and publications consistently refer to “toxic coal ash,” and environmental groups state that coal ash is a “highly toxic waste stream,” and that “coal ash is plainly and simply hazardous to your health.”
- The US Geological Survey (**USGS**) recently published a report that provides data for concentrations of metals and inorganics in **coal ash** from five power plants in across the US.
- The objective of this study was 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. **These screening levels are considered by the Agency to be protective for humans (including sensitive groups) over a lifetime.** Constituents in coal ash were also compared to background concentrations in soils in the US.
- 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 should not be classified as hazardous from 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 should also not pose a direct contact risk to human health.




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## 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. Alfthan,\* Steve Groves,\* William J. Batterton,\* William Benzel,\* Kelly L. Conrad,† Sharon M. Swanson,\* Leslie F. Roggero,\* James G. Clough,\* Harvey E. Beklin,\* Allan Kollec,\* and James C. Howell\*



\*Pamphlet in 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

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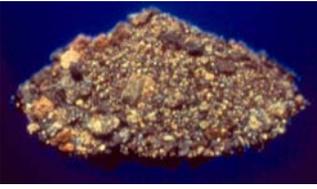

## What are CCPs?



**Fly Ash**



**Boiler Slag**

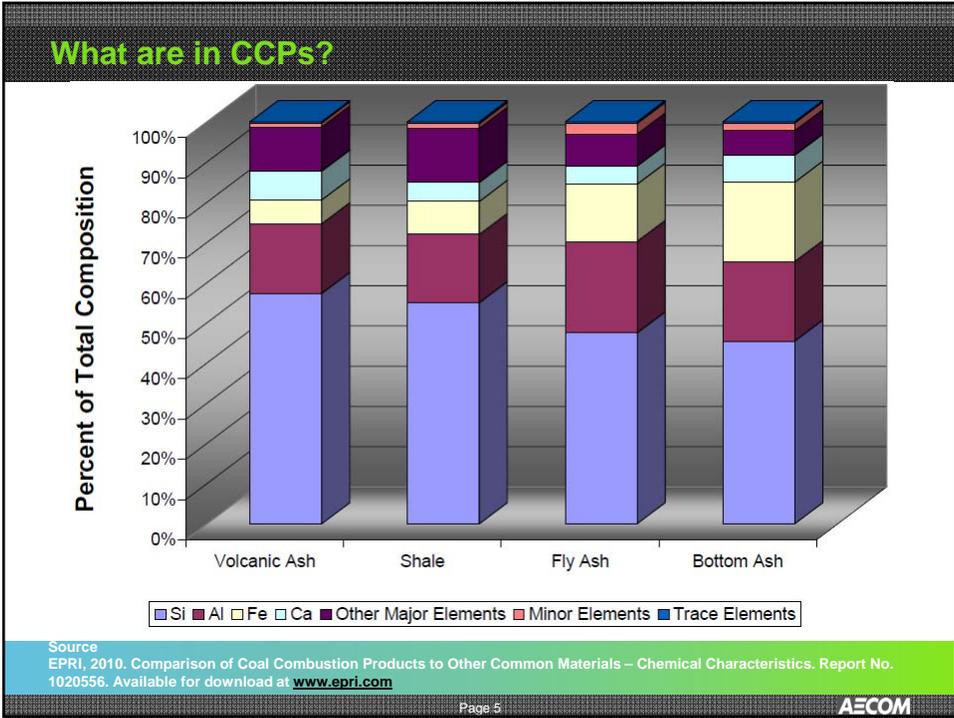


**Bottom Ash**



**FGD Gypsum**

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### 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

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## 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.



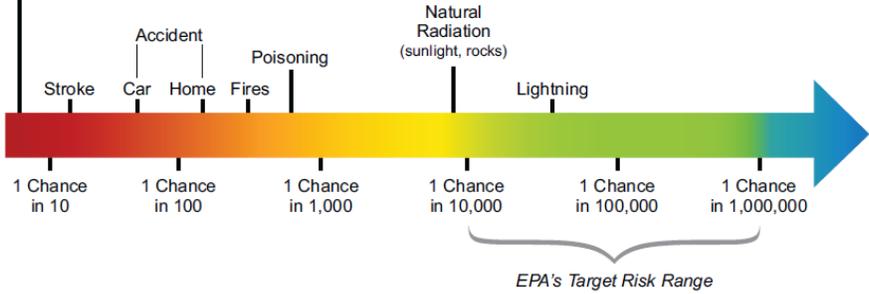

RSLs: USEPA. May 2012. Values for residential soil. [http://www.epa.gov/req3hwmd/risk/human/rb-concentration\\_table/index.htm](http://www.epa.gov/req3hwmd/risk/human/rb-concentration_table/index.htm)

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## 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, 2010) is  
1 Chance in 2 to 1 Chance in 3



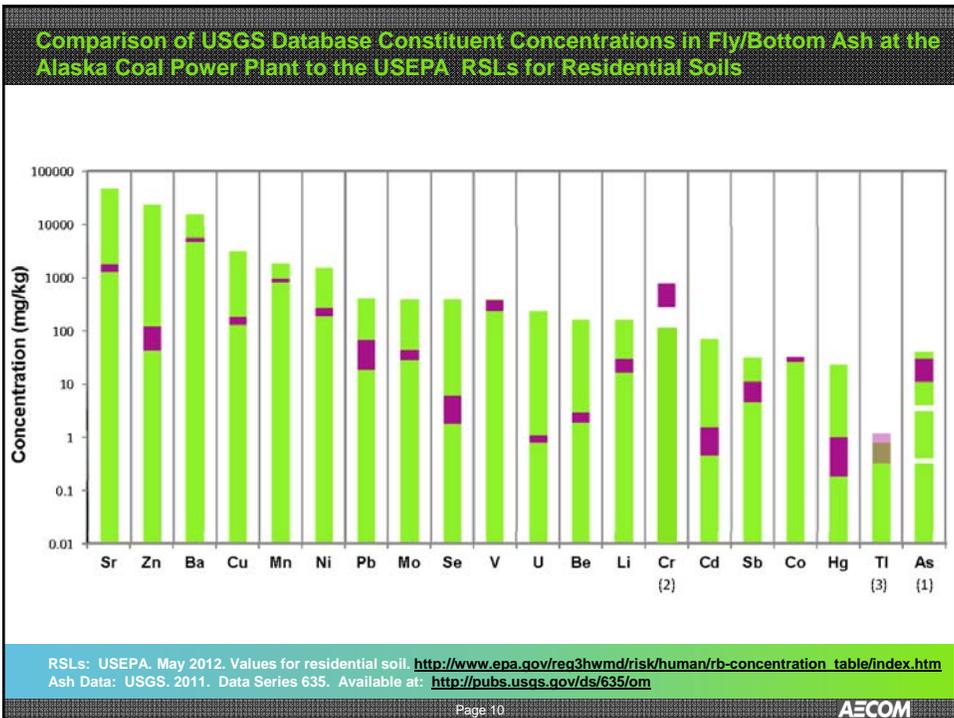
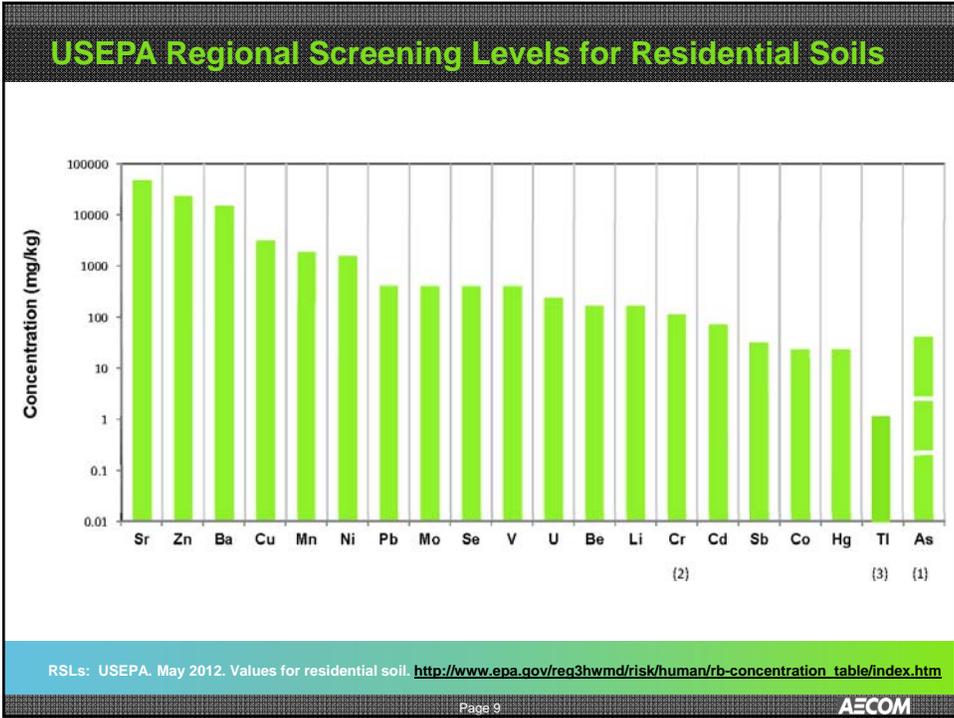
Risk Event	Lifetime Risk
Stroke	1 Chance in 10
Car	1 Chance in 100
Home	1 Chance in 100
Fires	1 Chance in 1,000
Poisoning	1 Chance in 1,000
Natural Radiation (sunlight, rocks)	1 Chance in 10,000
Lightning	1 Chance in 100,000
EPA's Target Risk Range (Start)	1 Chance in 10,000
EPA's Target Risk Range (End)	1 Chance in 1,000,000

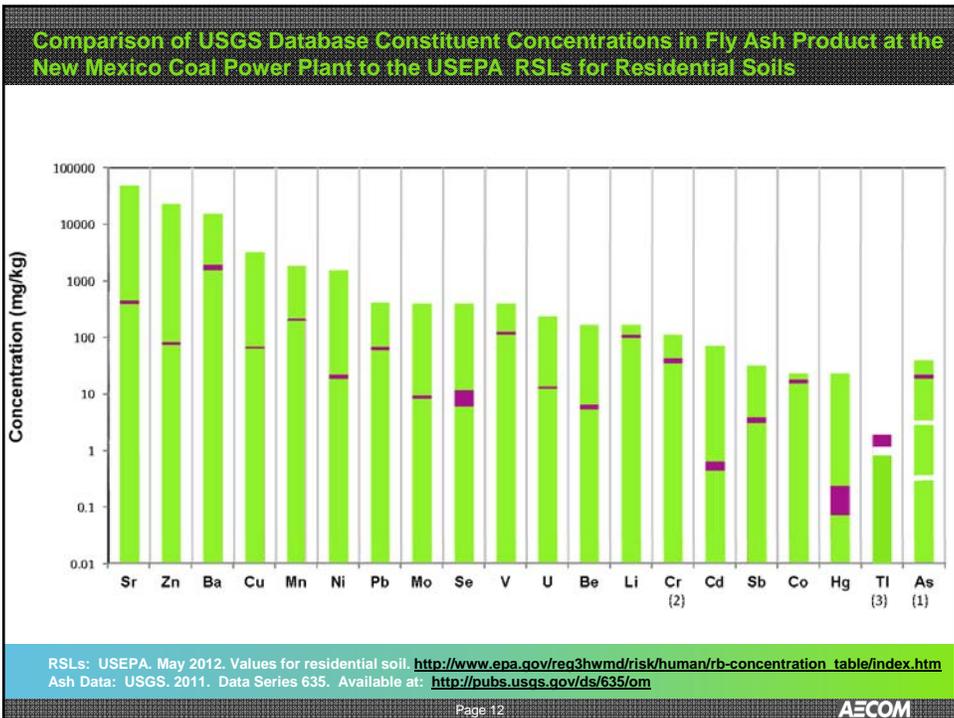
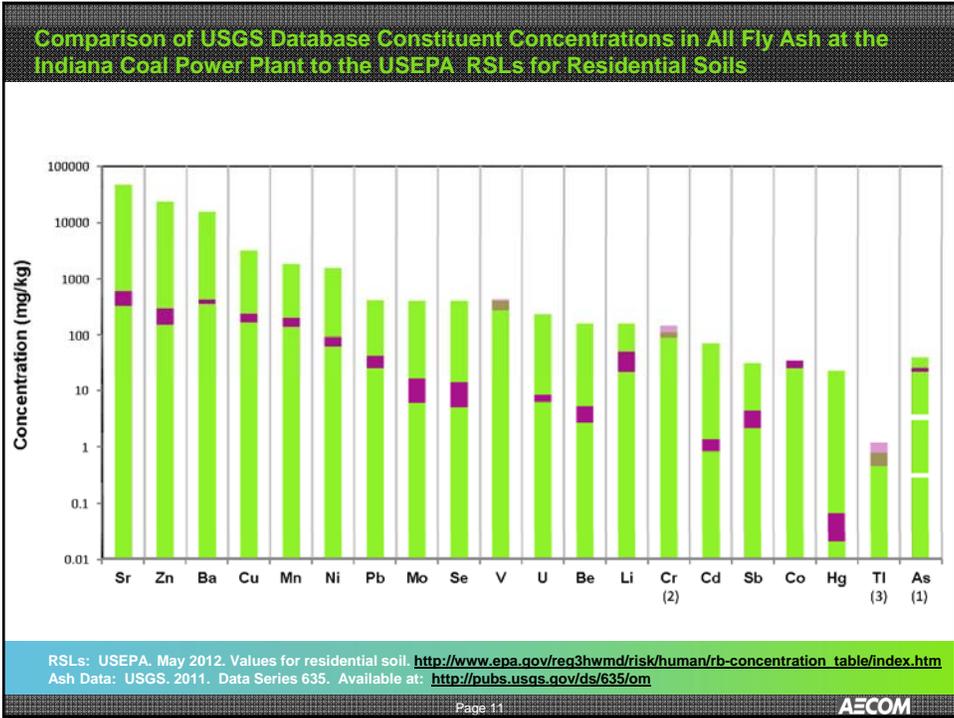
EPA's Target Risk Range

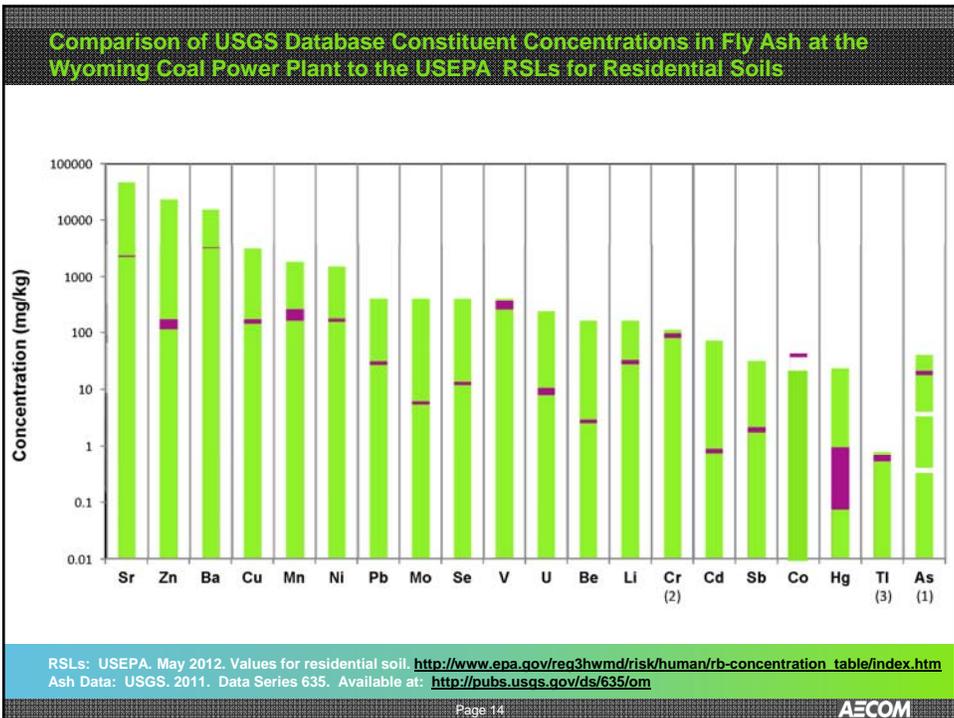
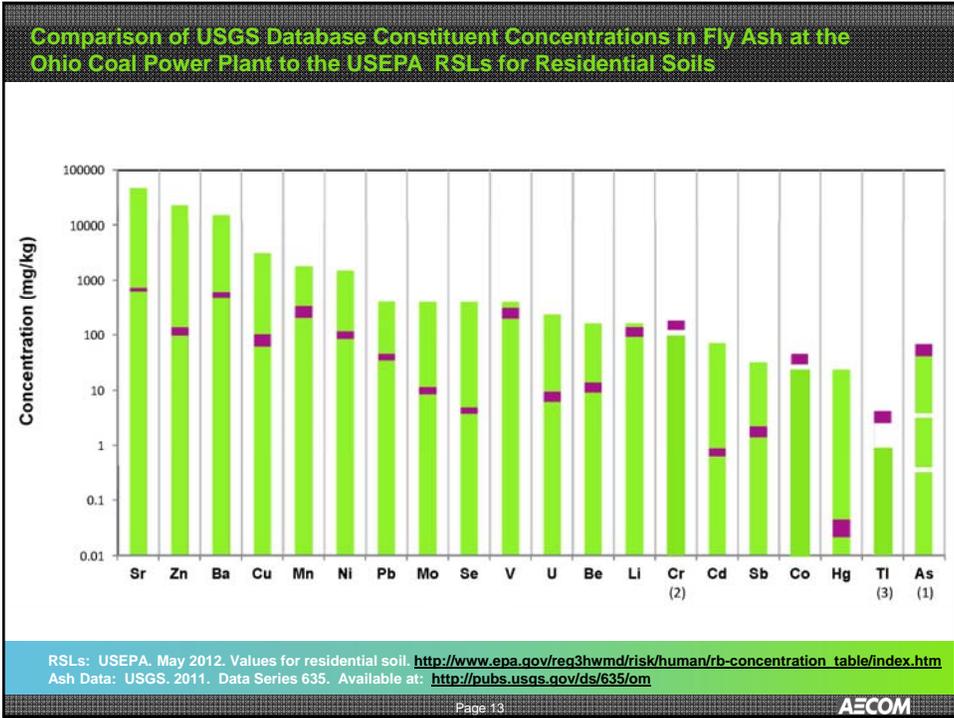
**Sources**

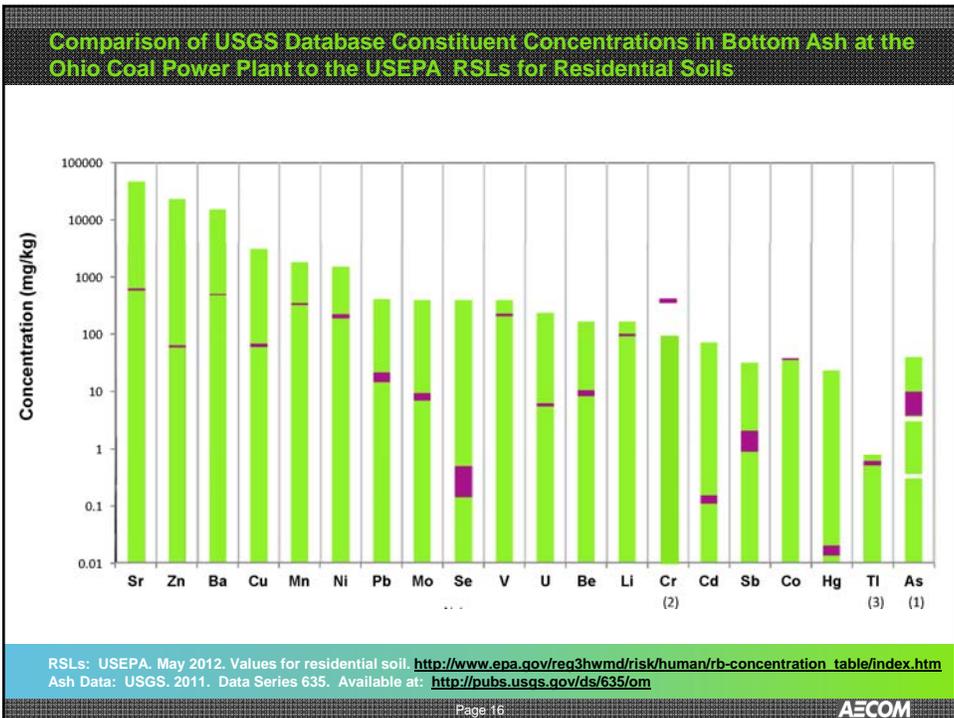
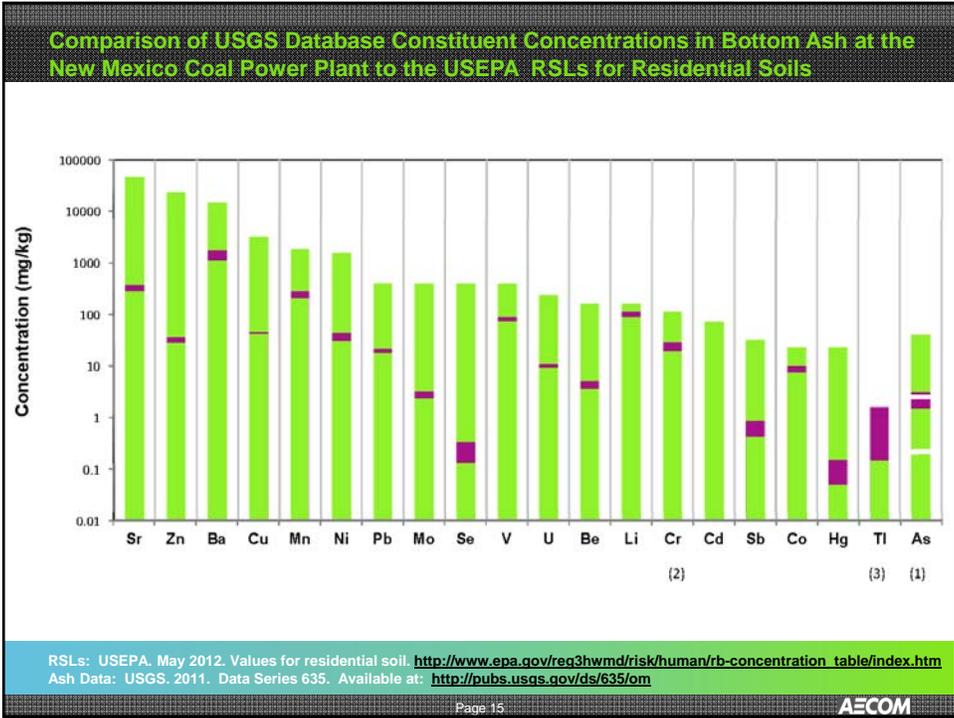
- Adapted from U.S. EPA 450/3-90-022, Mar. 1991, [http://www.epa.gov/air/oaqps/air\\_risc/3\\_90\\_022.html](http://www.epa.gov/air/oaqps/air_risc/3_90_022.html) (1996)
- American Chemical Society. 2010. *Cancer Facts and Figures 2010* <http://www.cancer.org/acs/groups/content/@nho/documents/document/acspc-024113.pdf>

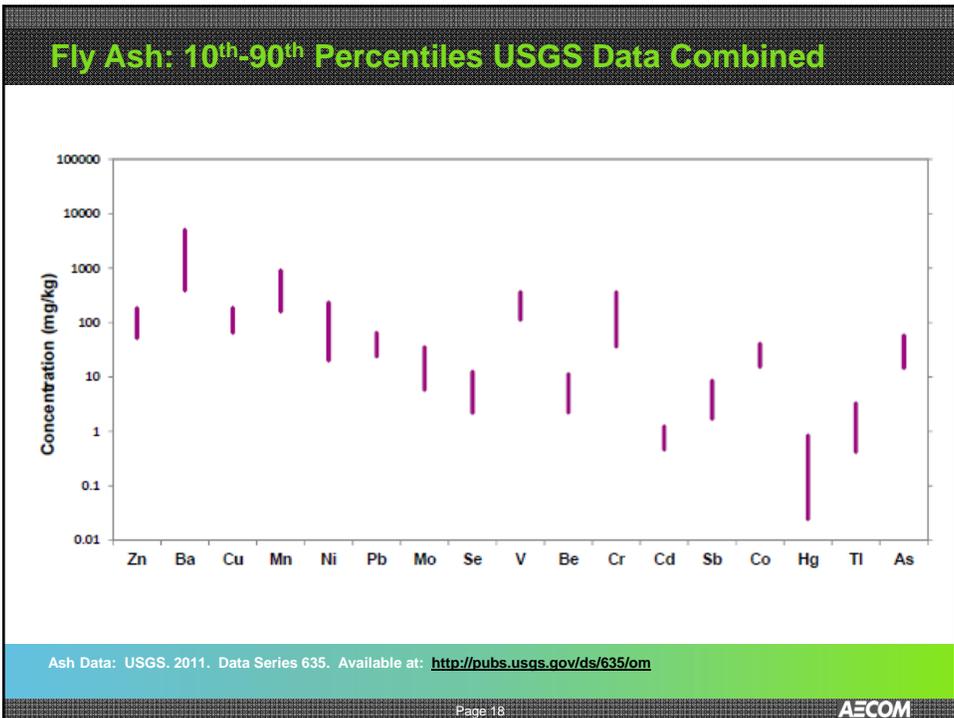
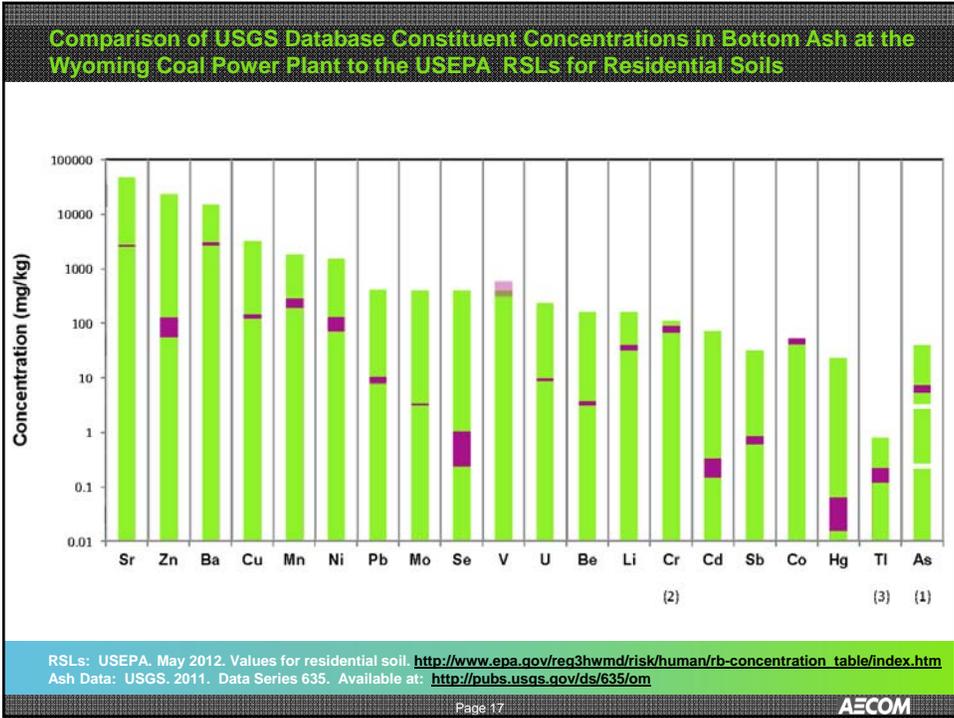
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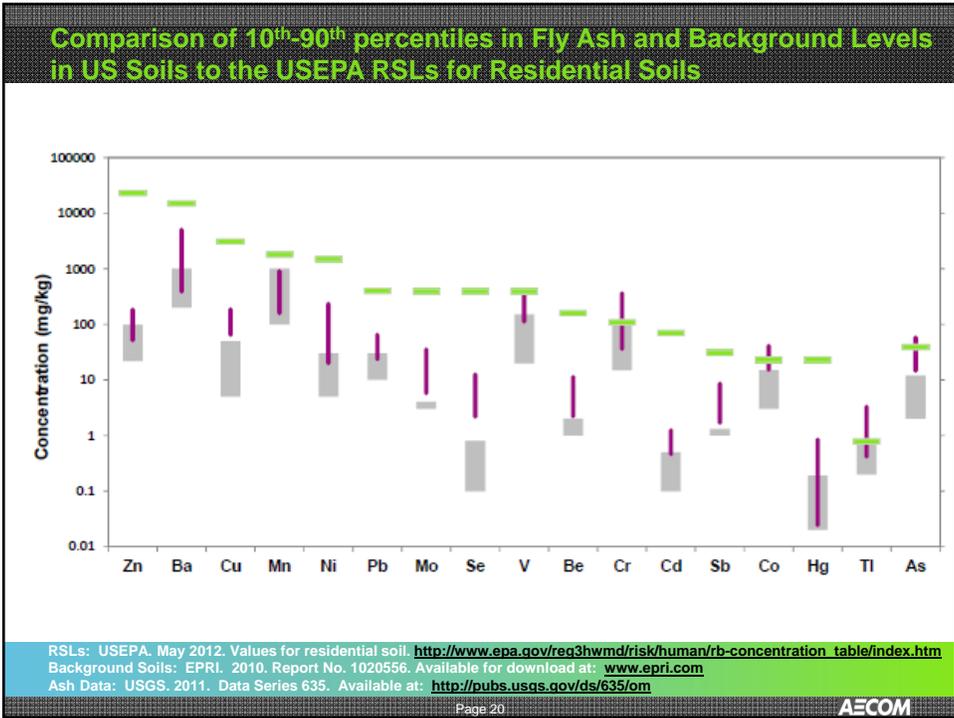
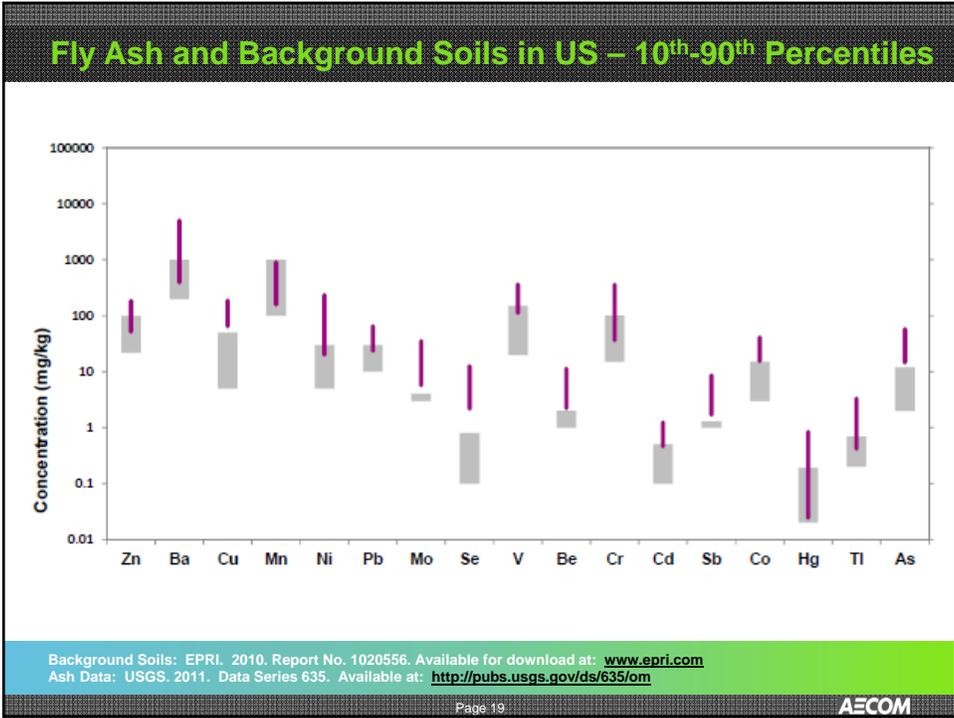


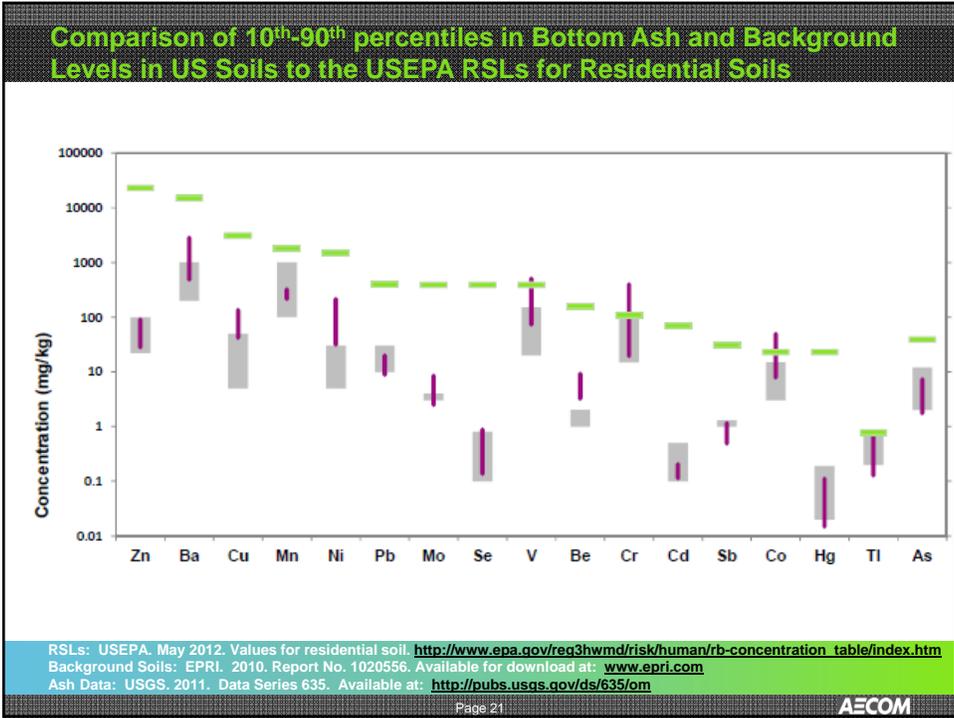












### Discussion and Context

- 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).

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## Discussion and Context

- Chromium
  - It has been assumed that all chromium is in the hexavalent form, which is very unlikely.
    - Data from the Alaska plant indicate that hexavalent chromium is only 0.25% of the total chromium.
  - There are many uncertainties with the hexavalent chromium screening levels – for this evaluation, current USEPA verified values were used.
- Cobalt
  - The toxicity value for cobalt is a provisional value. Other regulatory agencies have declined to develop a long-term toxicity value for cobalt citing a “lack of suitable data.” The estimated dietary intake in the US is higher than the toxicity value.
- Thallium – the provisional document for the toxicity value notes:
  - “For the reasons noted in the main document [because of limitations in the database of toxicological information], it is inappropriate to derive a provisional subchronic or chronic p-RfD for thallium.”
  - However “...an appendix with a “screening subchronic and chronic p-RfD” is provided, recognizing the quality decrements, which may be of value under certain circumstances”

Region	Concentration (mg/kg)
Chromium A, NE	10000
Chromium A, S	0.25
Chromium A, SE	200
Chromium A, E	100
Chromium A, W	200

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## 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.

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