Generation and Energy Marketing

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Mercury Control
A Utility Perspective

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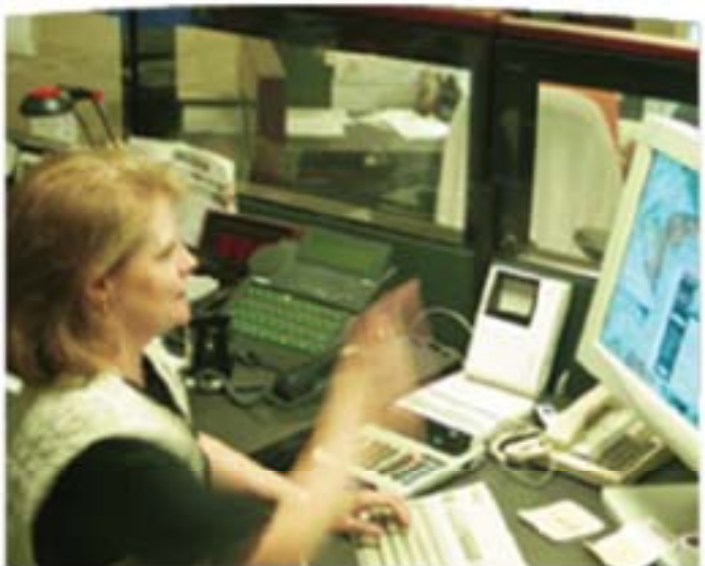

Outline

- Mercury in coal-fired utility plants
- World-wide mercury cycle
- Commercial control technologies
  - FGD co-control
  - Activated carbon injection
- Human exposure changes

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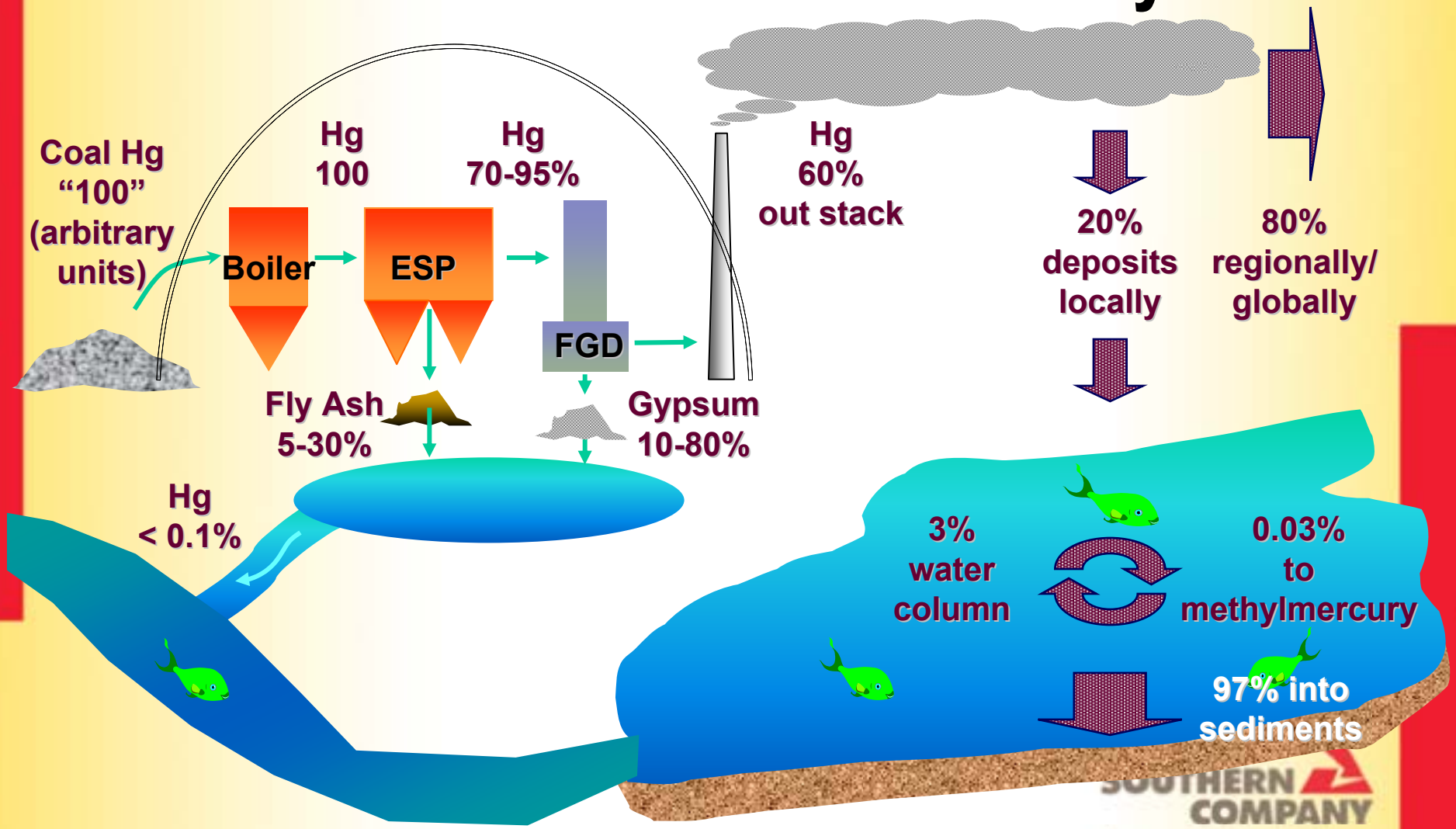
Fate of Power Plant Mercury



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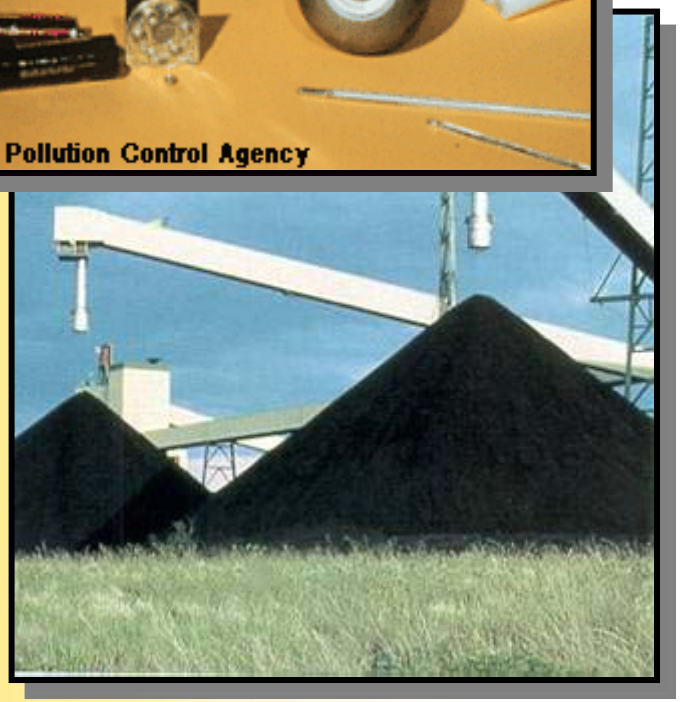

Mercury in Coal

- **Coal has very little mercury!**

Coal	**50 ppb**
Larry	**20 ppm**
Fluorescent light bulb	**175 ppm**
Thermometer	**10,000 ppm**

- **But the industry burns a lot of coal!**

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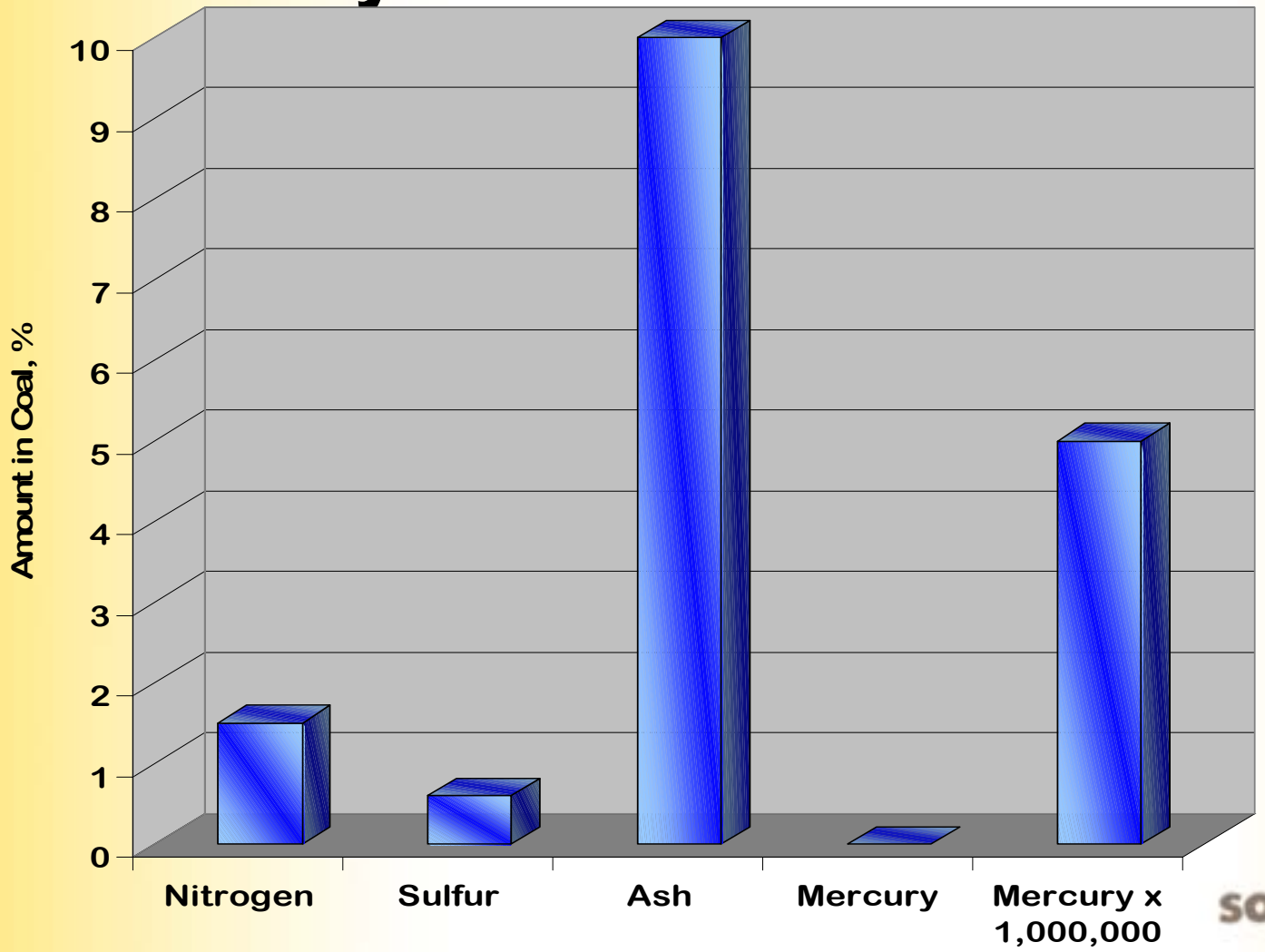
Mercury & Other Pollutants in Coal



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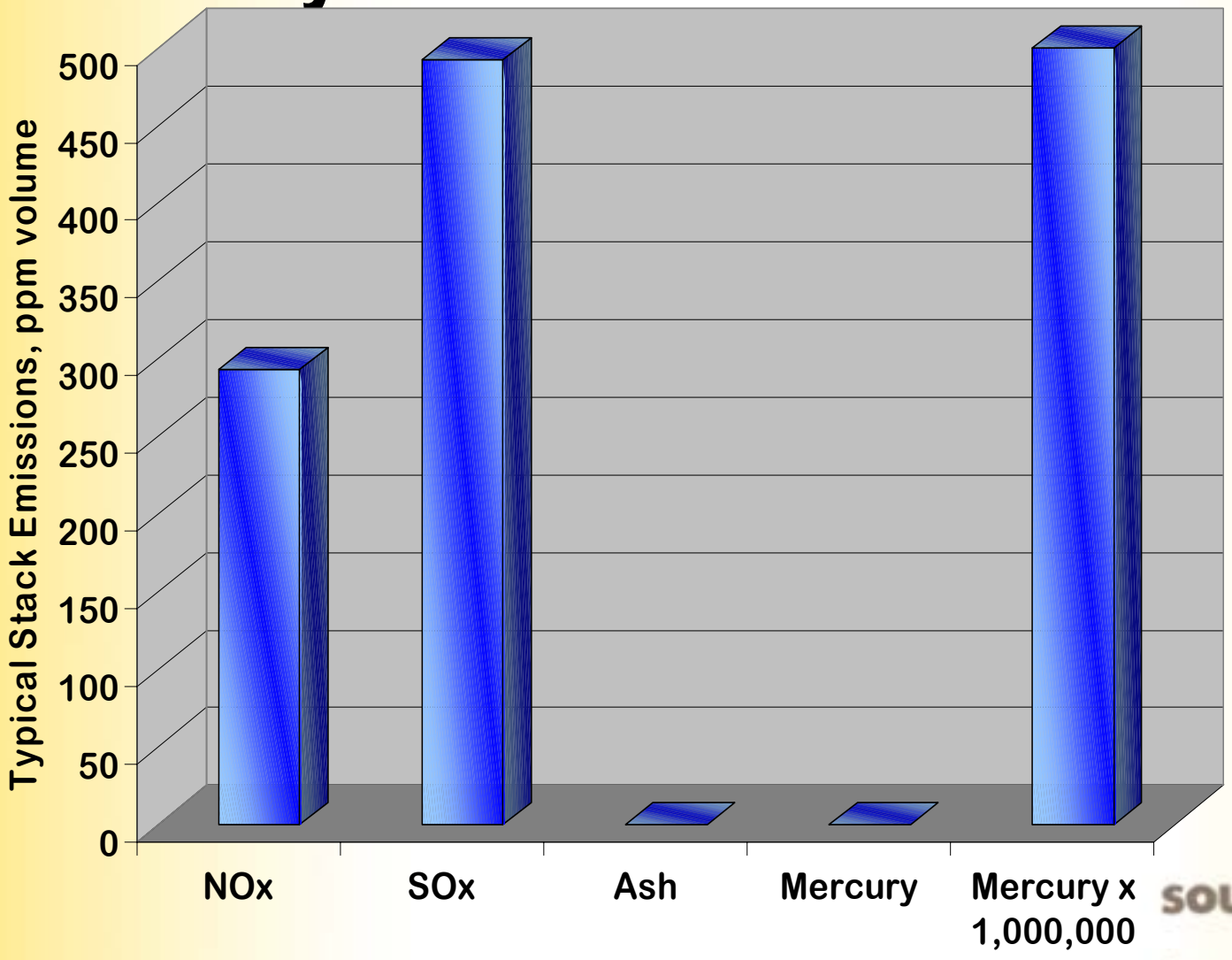
Mercury & Other Pollutants in Stack



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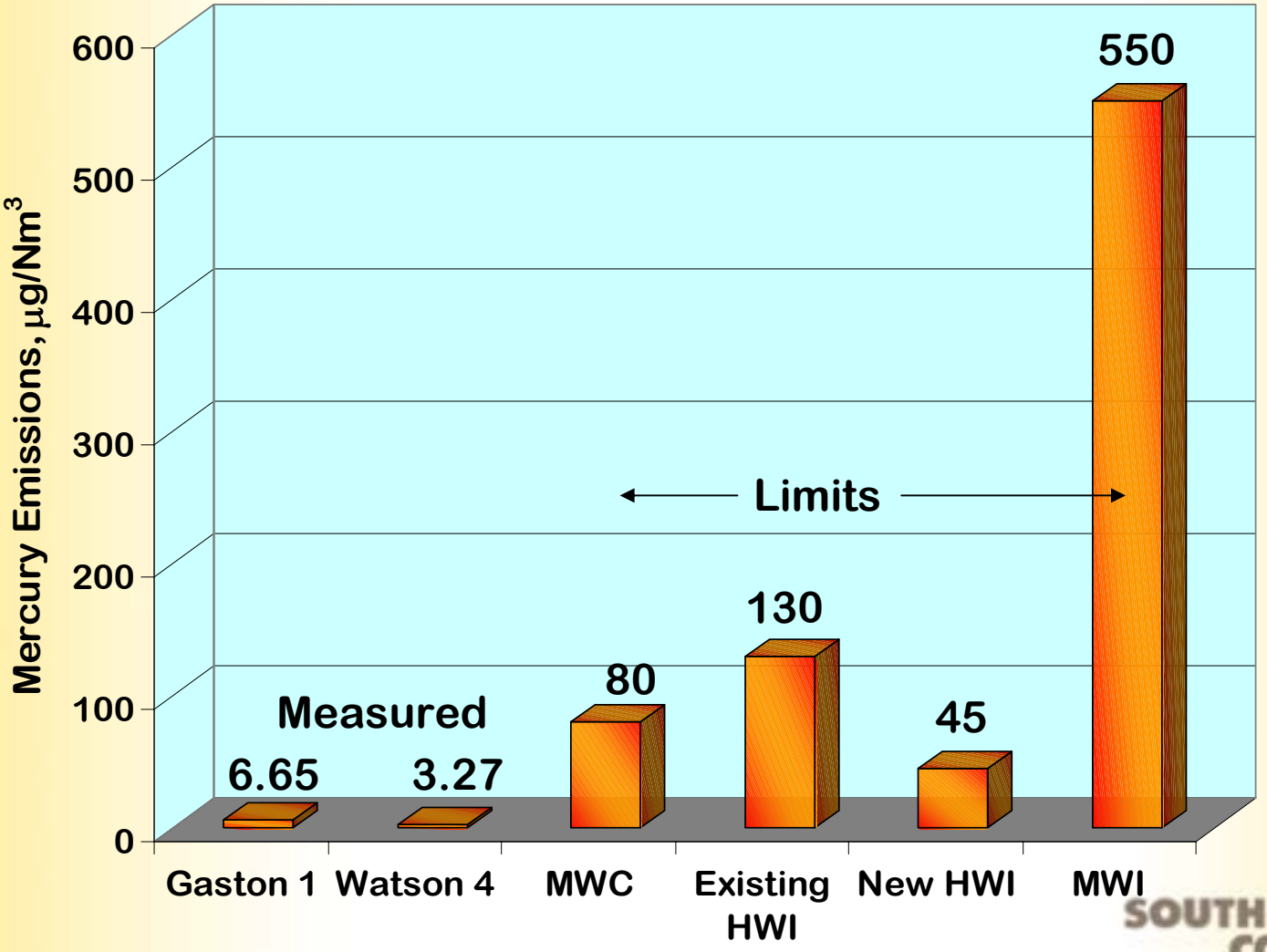
Coal vs. Other Controlled Sources



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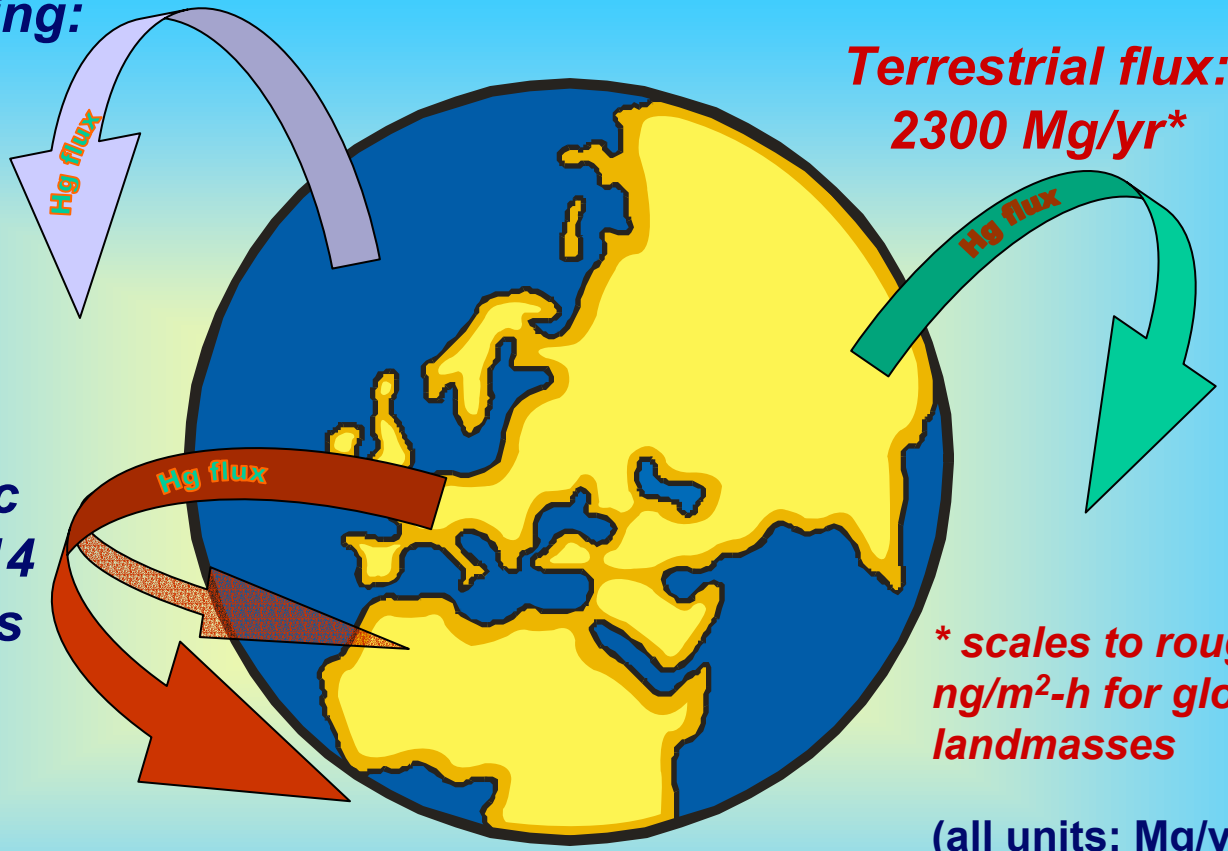
Mercury Balance - Global Atmosphere

Ocean Outgassing: 2000 Mg/yr



Terrestrial flux: 2300 Mg/yr*

Anthropogenic emissions: 2214 Mg/yr (1/2 goes to local deposition)

* scales to roughly 1.8 ng/m^2-h for global landmasses

(all units: Mg/yr = 10^6g/yr = metric tons/yr)

Global atmospheric lifetime (Hg^0): 1-1.5 yr

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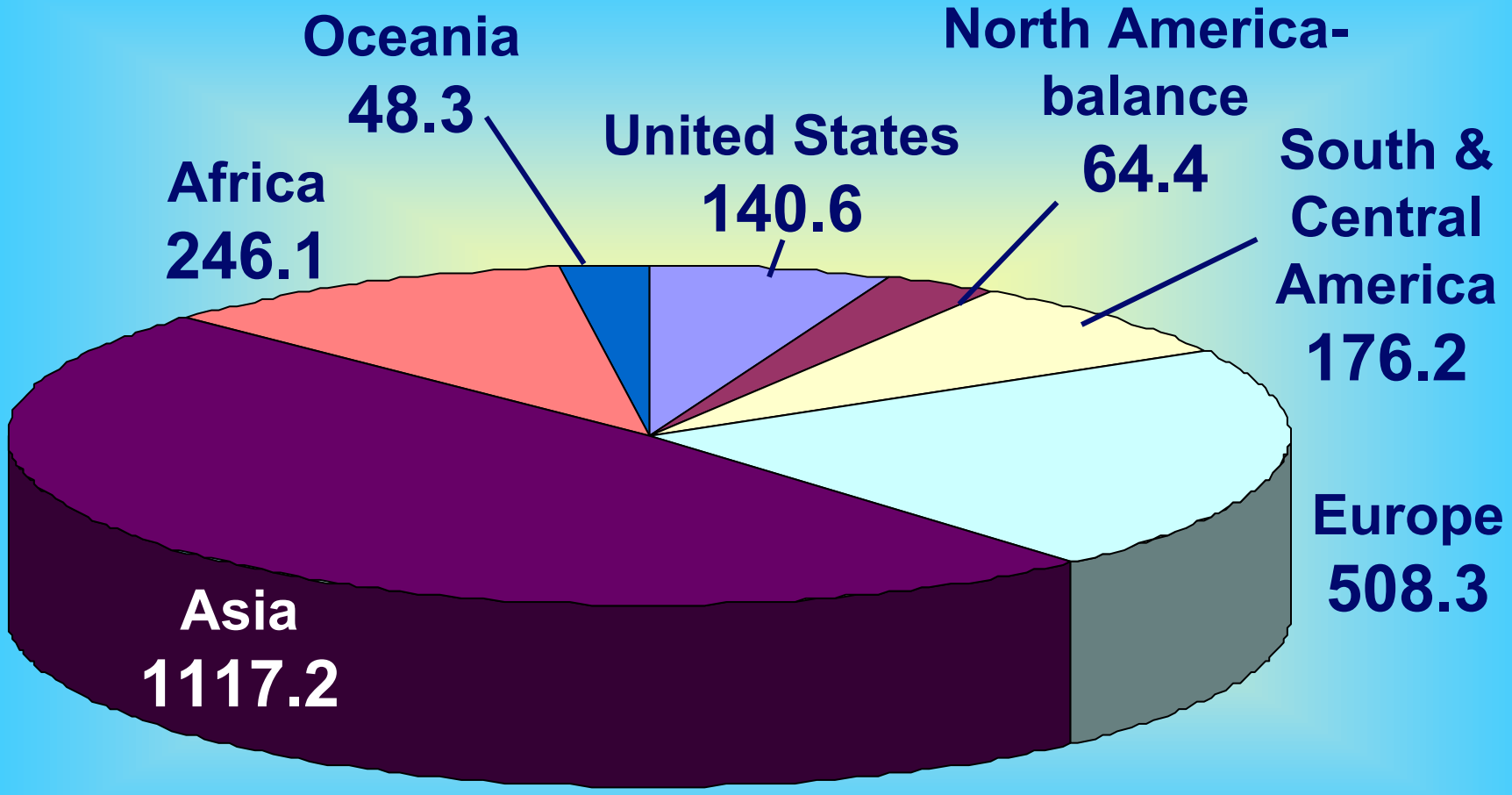
Contribution to Global Emissions (Mg/y)



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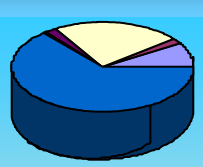
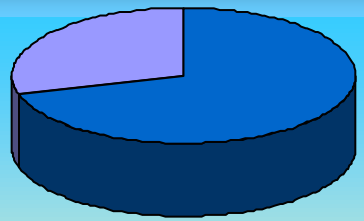
Mercury Sources in North America

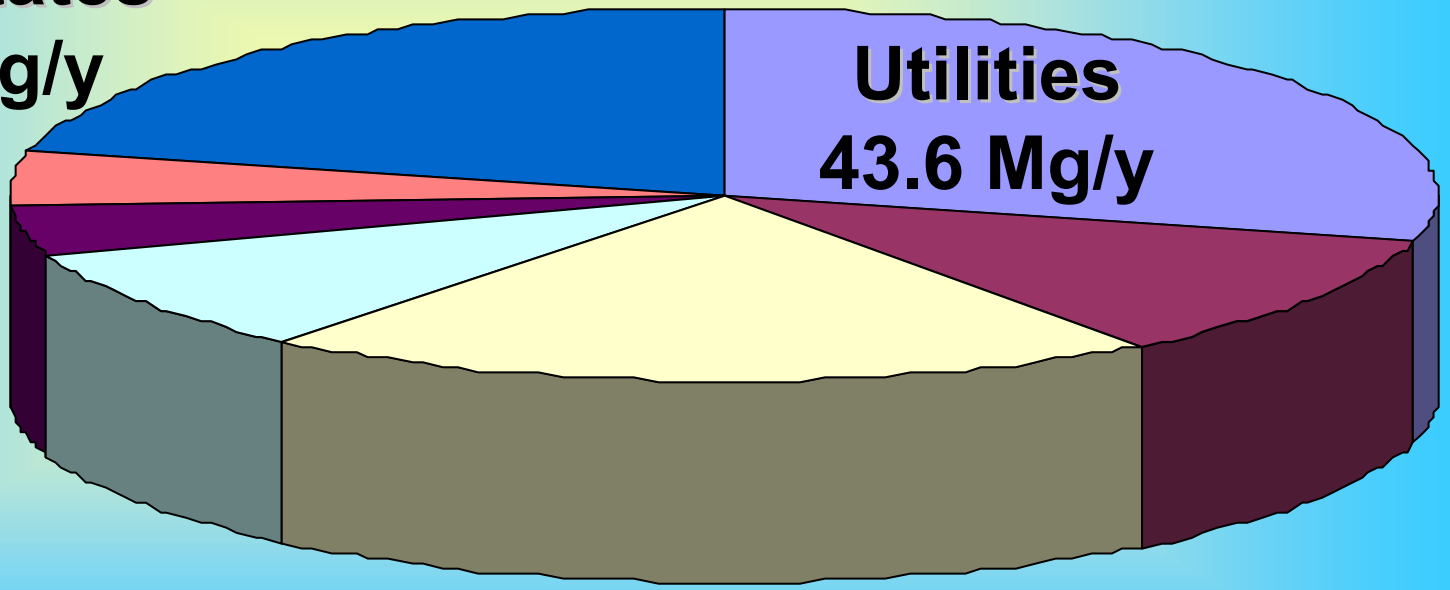
Southern Canada
14.7 Mg/y





Northern Mexico
33.5 Mg/y

United States
140.6 Mg/y



- Electric utilities
- Iron processing
- Waste incineration
- Other coal burning
- Mining
- Chloralkali facilities
- Other sources

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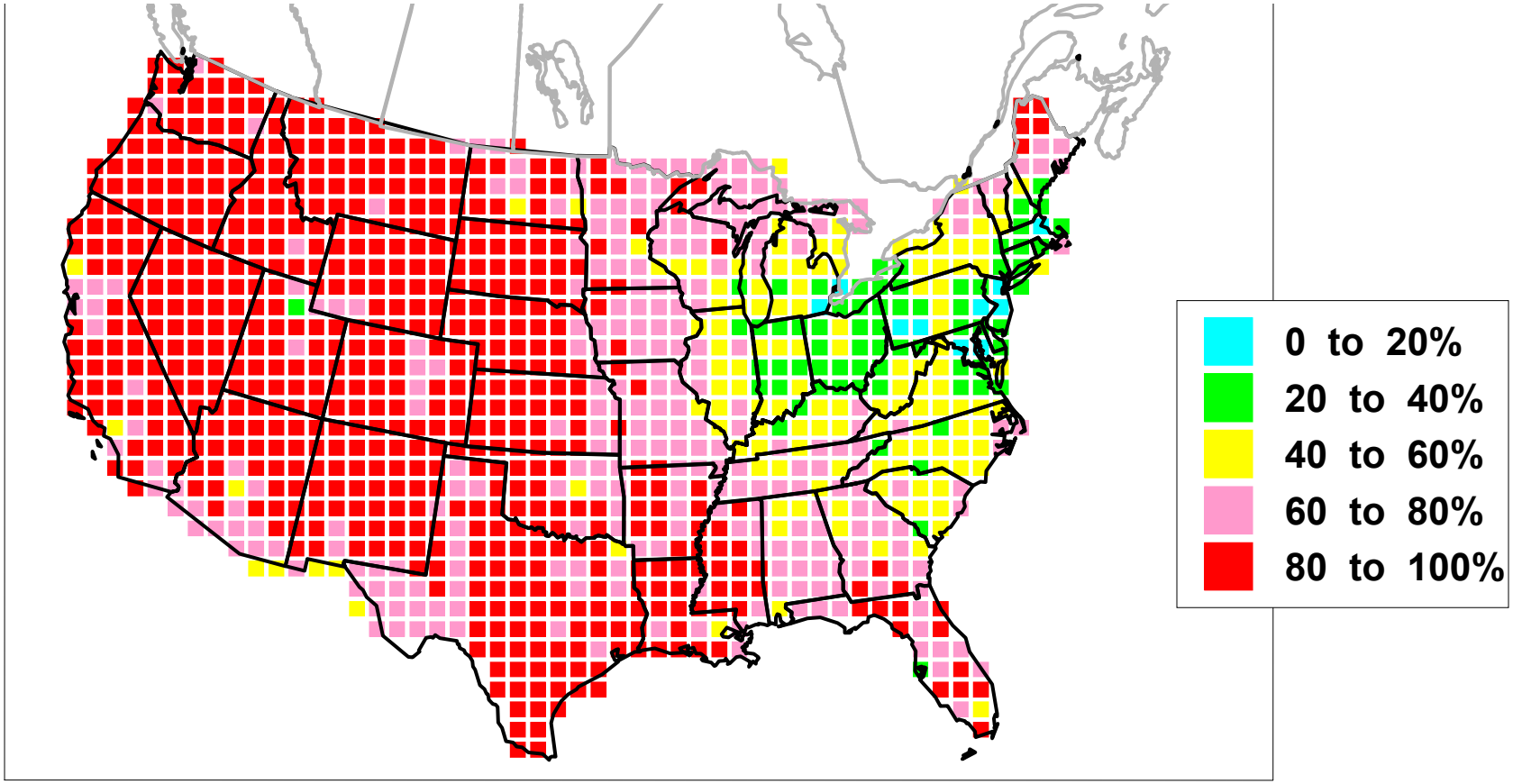
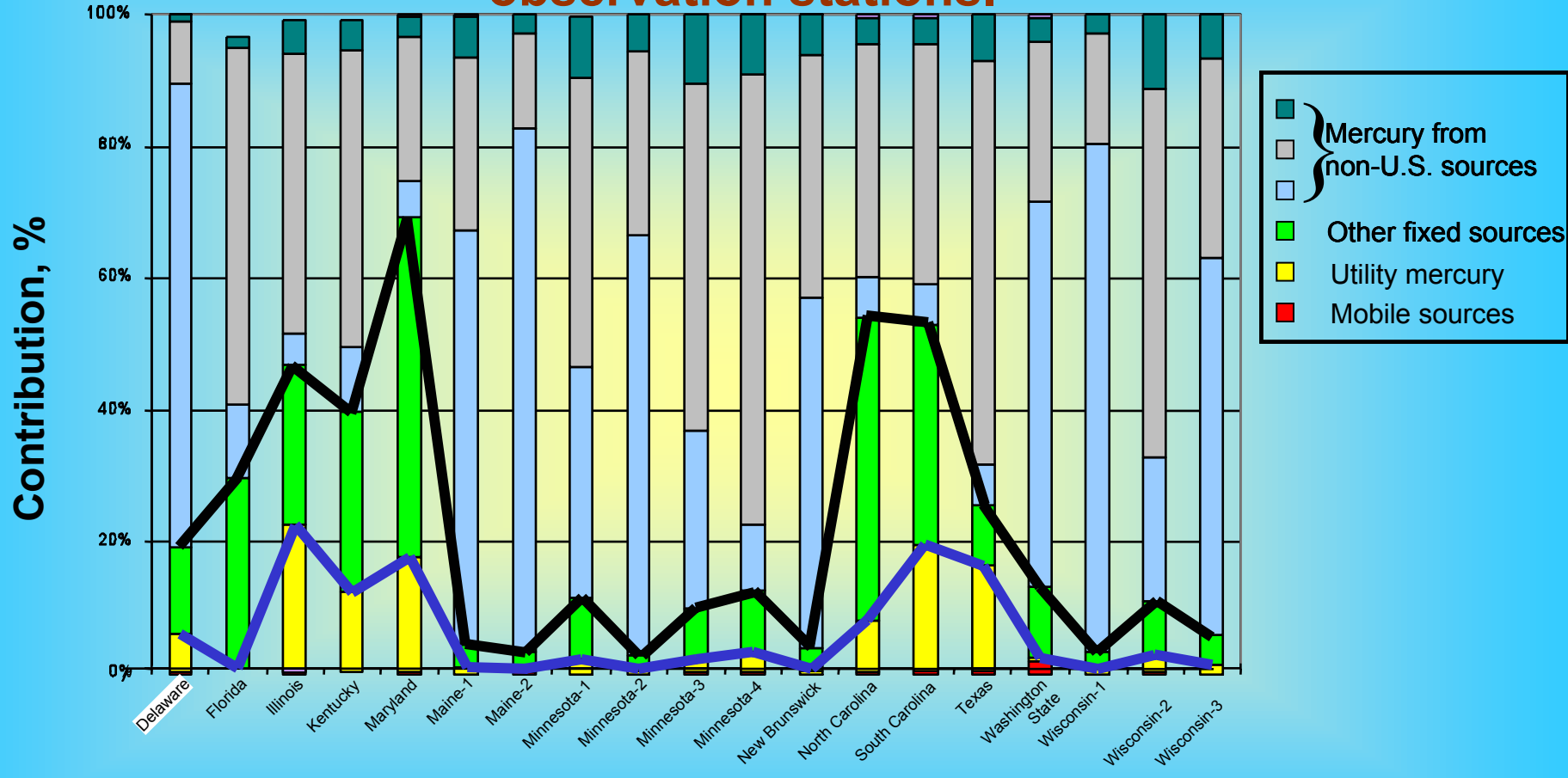
How much mercury depositing in the United States originates outside the country?



How much does utility mercury contribute?

Results of EPA model runs: contributors to mercury depositing at observation stations.



EPA REMSAD model runs for Lake Michigan Air Directors Consortium, Jan. 2002

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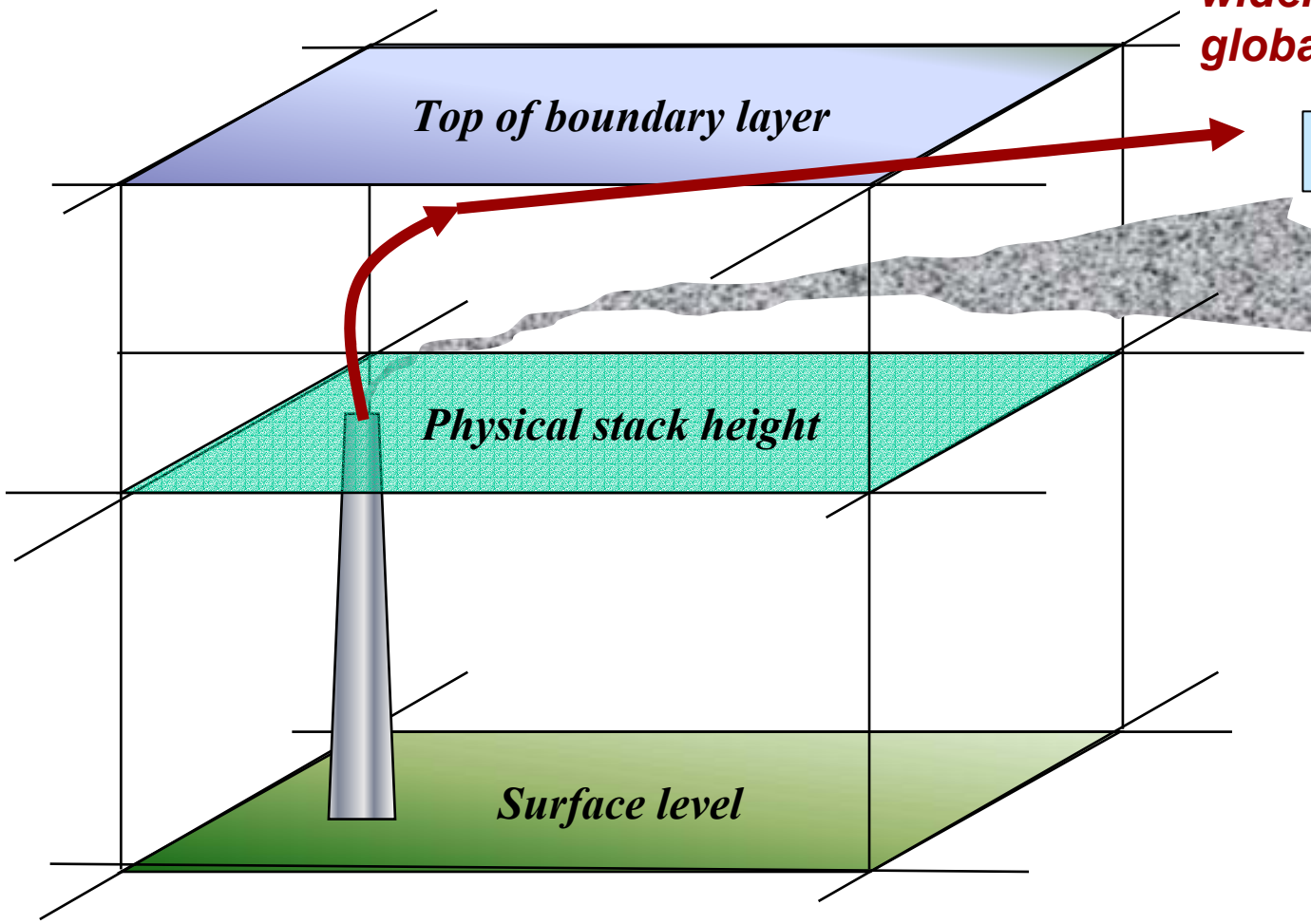
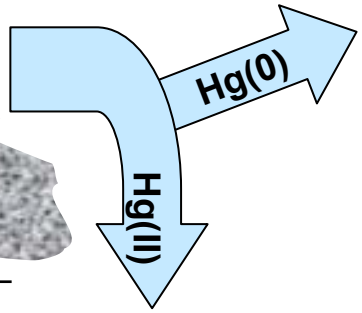
Plume behavior



Hg(0) tends to disperse widely into regional and global background



Hg(II) tends to deposit closer to source at higher concentrations

Plant Bowen Mercury Plume Studies

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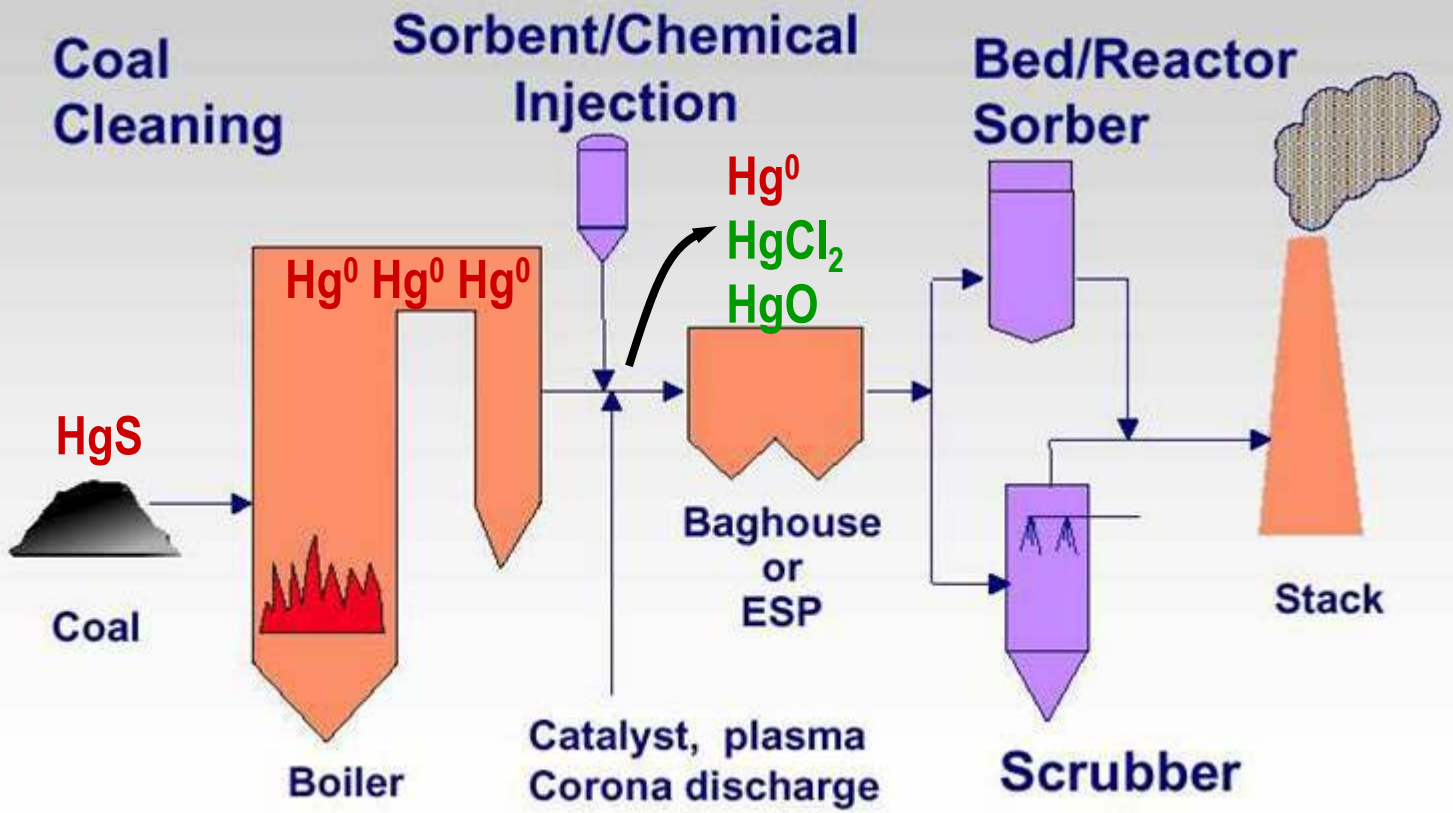
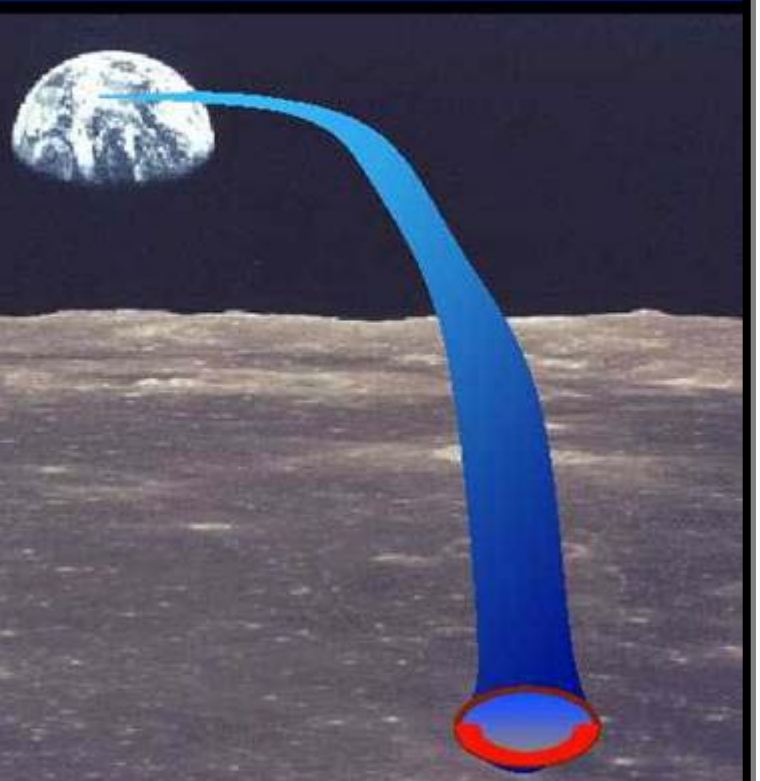
Mercury Removal Options



Mercury in Power Plant Stacks

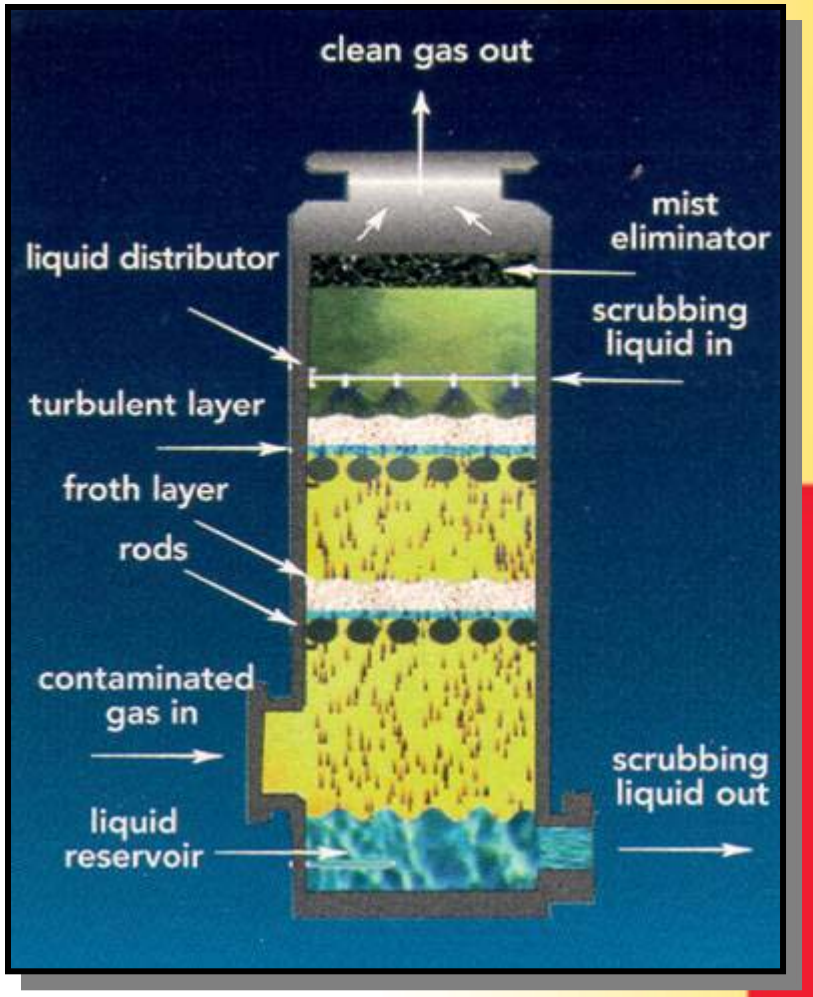
If a 1-foot diameter pipe extending *238,000 miles* from the earth to the moon were filled with the stack exhaust from a single power plant, the mercury in that pipe would equal a section *18 inches* long.

(thanks to Tom Brown of DOE)



FGD Co-Control

- **Oxidized Hg (soluble)** is captured with same % as SO_2
- **Elemental Hg (insoluble)** not captured
- Some FGD show capture, conversion, & re-release
- Challenges:
  - Convert to Hg^{2+}, possibly w/ SCR
  - Prevention of re-release
  - Eventual fate

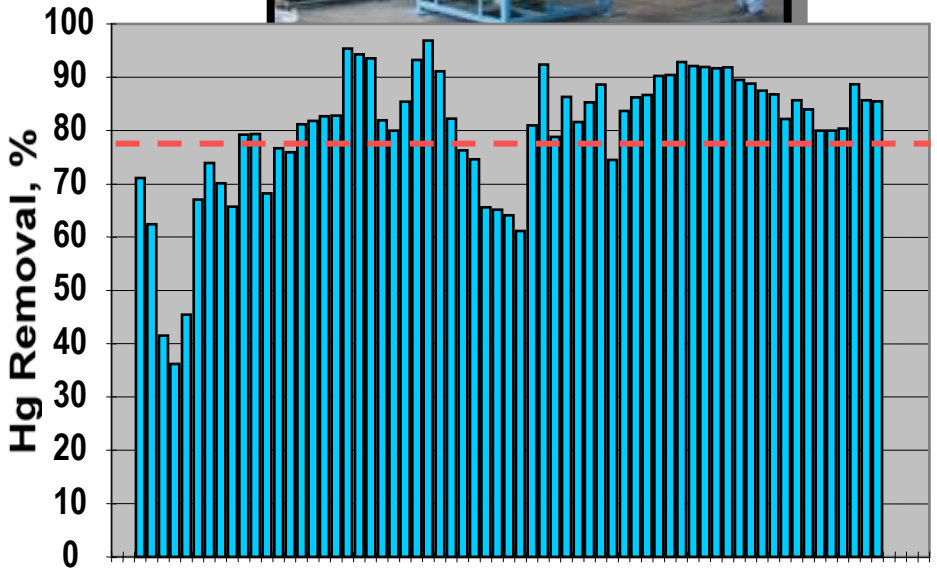


Mercury Control by Activated Carbon

- Activated carbon is a chemical sponge, used mainly in water treatment
- Captures mercury from flue gas
- Baghouse is efficient
- Eventual fate of mercury not known

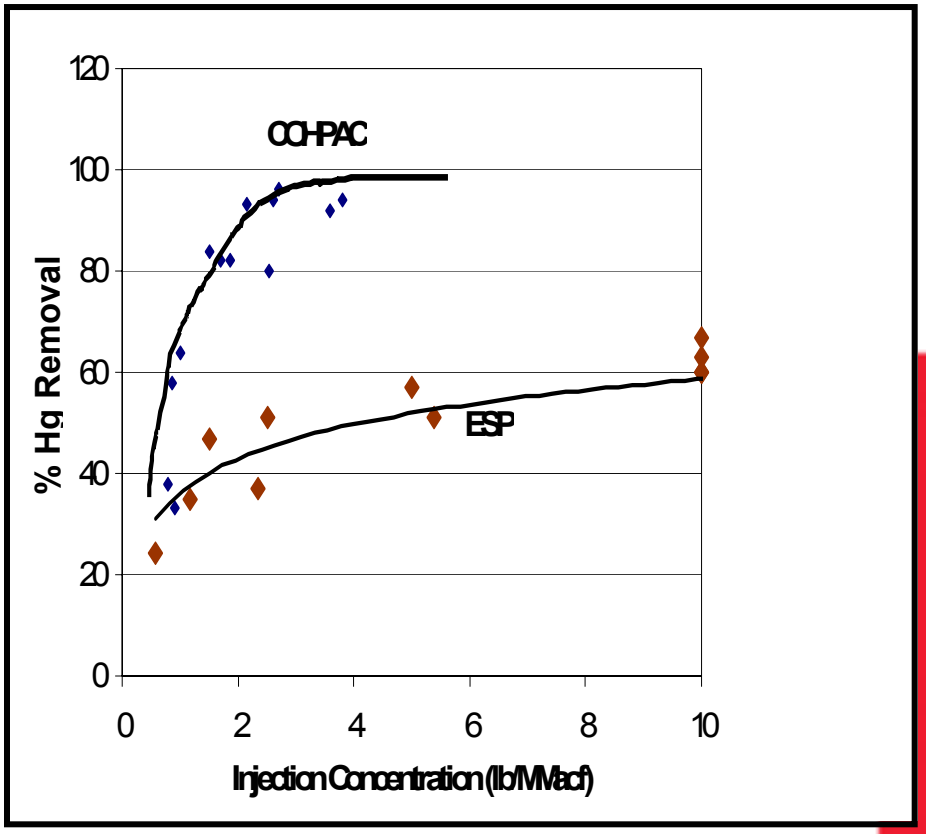
Baghouse Carbon Injection

- First full-scale demonstration of power plant mercury control: Plant Gaston - 2001
- Activated carbon injected into existing COHPAC baghouse
- Average removal of 78%, removals of 36% to over 90%
- Proposing long-term demonstration



ESP Carbon Injection

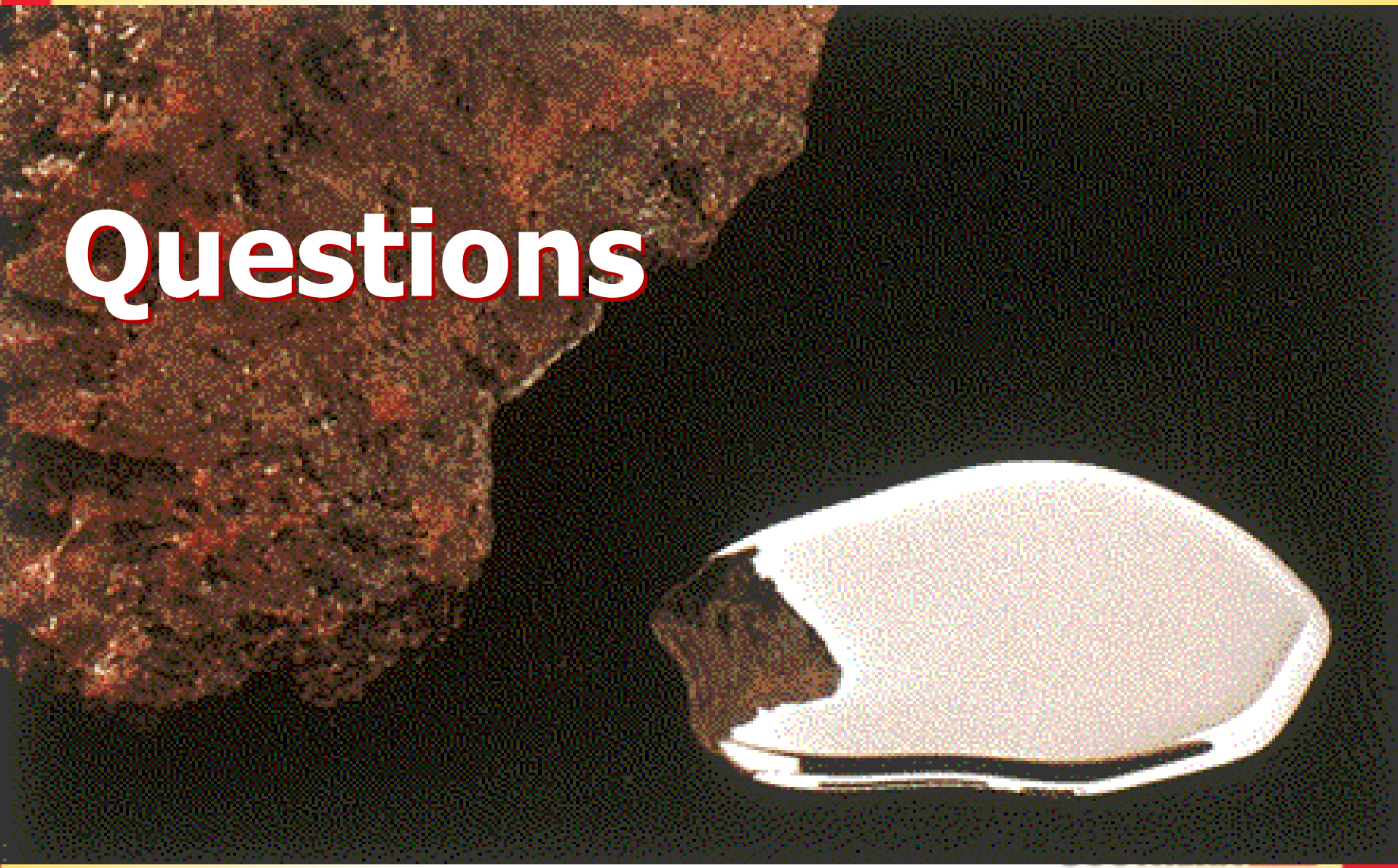
- Late 2001 Demo at WEPCO - PRB coal
- Activated carbon injected into large cold-side ESP
- Removals peaked at 65%
- Cooling flue gas did not increase capture
- Significant by-products impacts



How will controls on utility mercury change exposure to mercury by fish consumers?

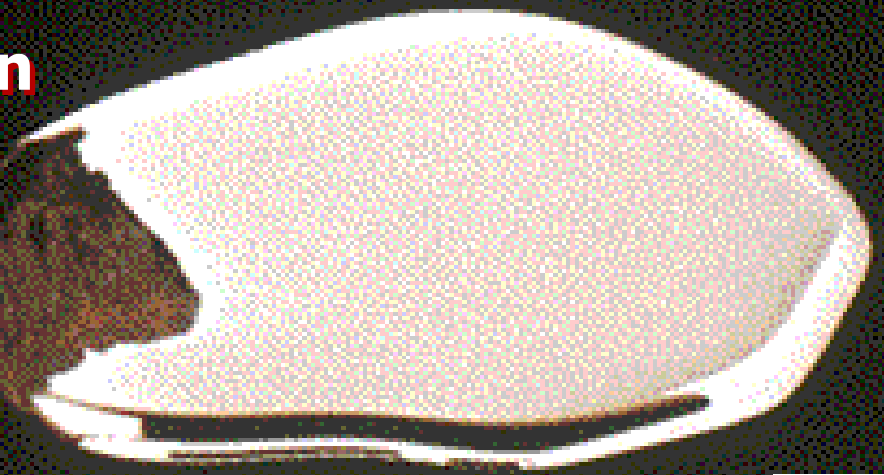
- Changes in deposition
  - Cut in emissions of 47% (23 tons/yr) total
  - Drop in deposition of 3.4% (6.2 tons/yr) total
- Exposure due to freshwater fish consumption (NHANES 30-day).
  - 31% of fish meals → freshwater (incl "other", "unknown" fish)
- Assume: 20% of trout, catfish, other, unknown fish meals are *wild* freshwater fish + smaller fraction of other categories
- So, 8% of fish meals are freshwater wild fish.
- Change in exposure: average exposure reduction = 0.28%
- Location with greatest difference roughly 20x, or about 3%

Questions



Mercury

- Mercury, or quicksilver, is a noble metal like gold, silver, and platinum, and is the only common metal that is liquid at room temperature
- Mercury is the 67th most abundant element on earth, and is 13 ½ times as dense as water
- Mercury is a cumulative poison which causes brain damage and dementia- "Mad as a hatter"



Mercury Uses

- Scientific equipment
  - thermometers, barometers, diffusion pumps
- Medical
  - amalgam dental fillings, mercurochrome, etc.
- Industrial
  - mercury vapor lamps
  - batteries
  - gold & silver mining
  - paint pigments and poisons
  - ammunition
  - chlor-alkali chemical plants