Coal

« The Good, The Bad, & The Ugly

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Outline

- The Good: Coals use and abundance in the worlds energy consumption and how emissions can be recycled and controlled.
- The Bad: How coal is obtained, pollutes, and how its use can lead to disaster.
- The Ugly: Health effects from the emissions of coal combustion on the population.

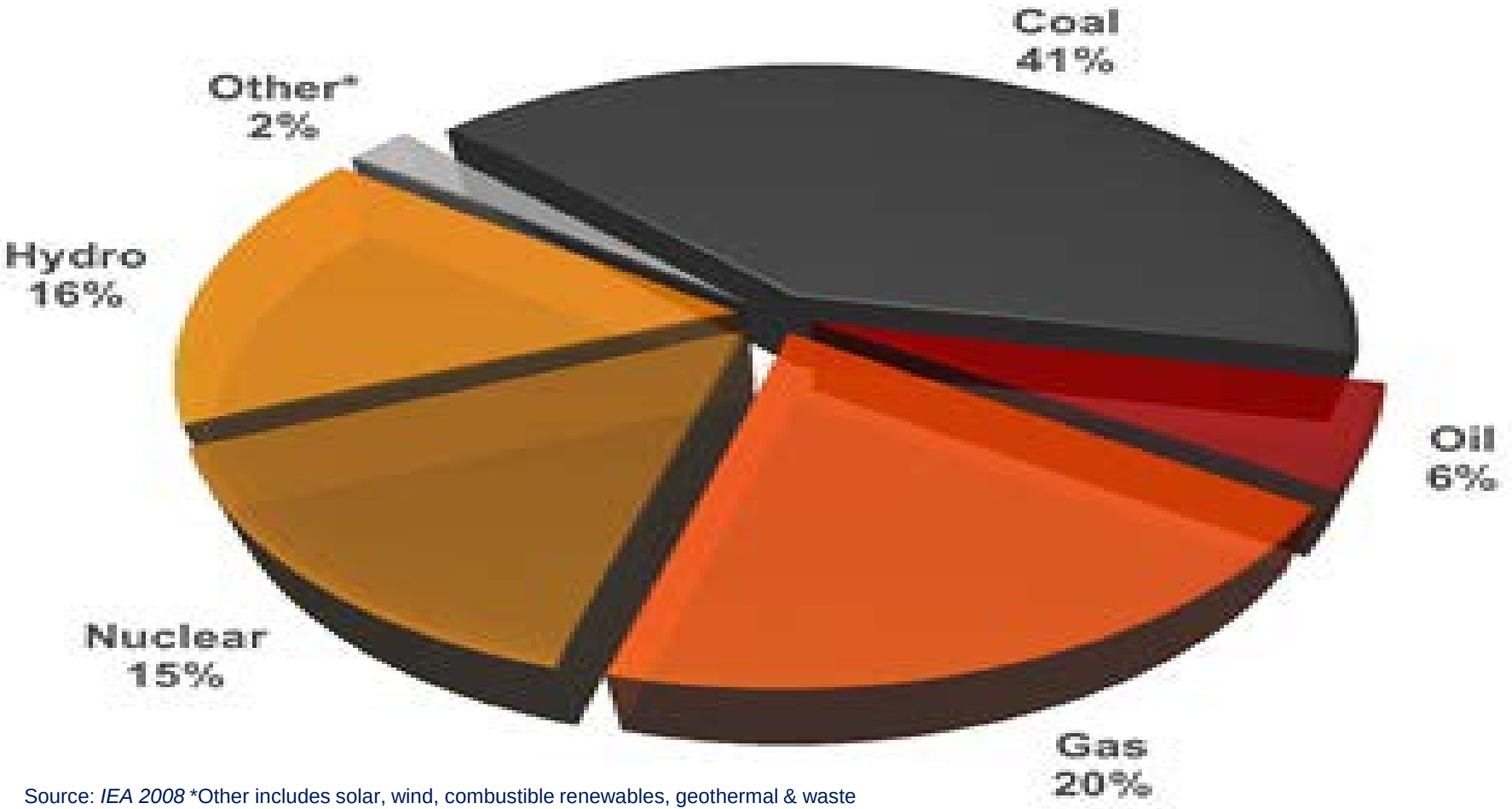
The Good

The Good

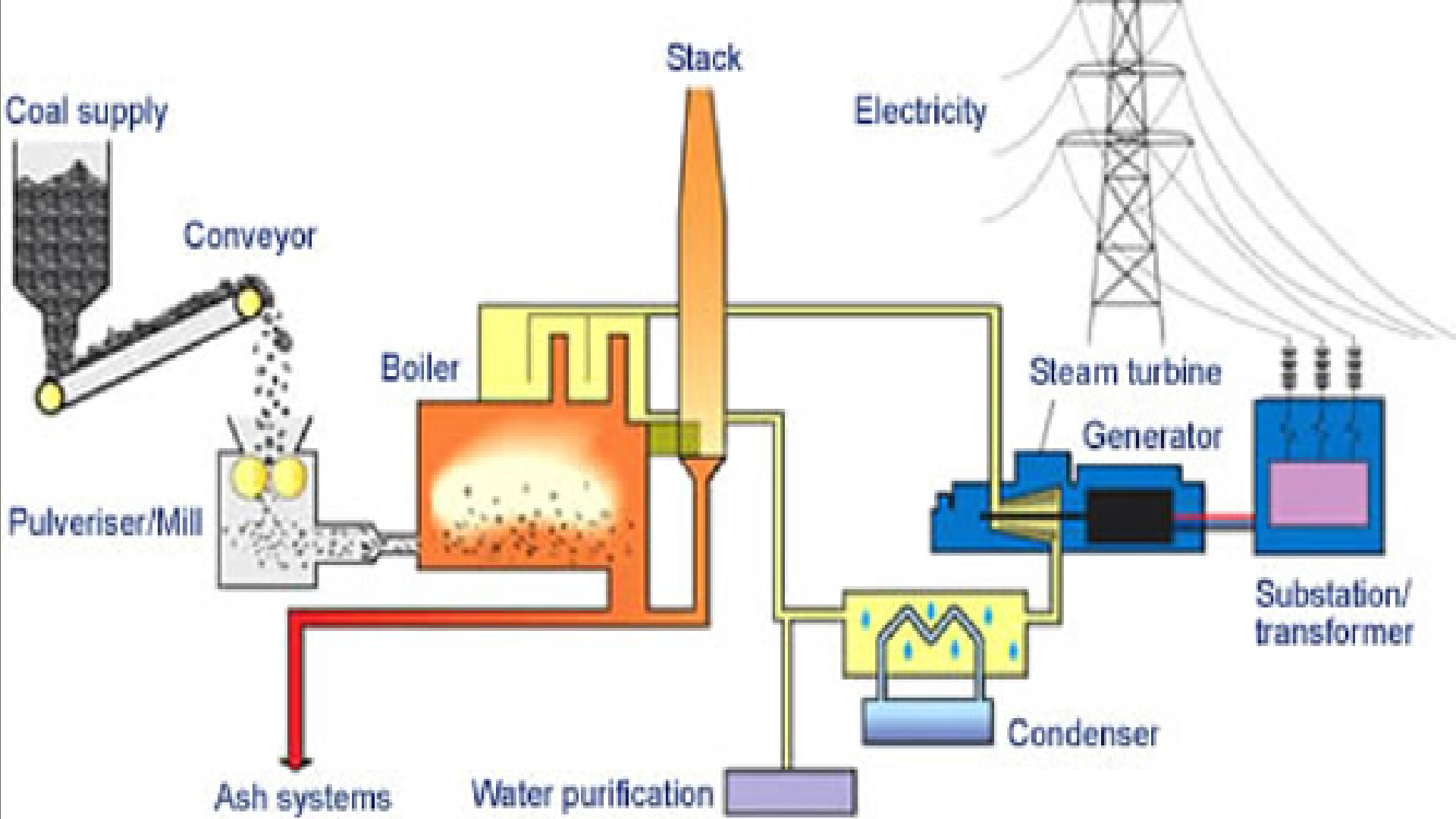
•Coal is the largest single source for electricity. Producing 40% of the world's power supply.

•In the U.S. coal produces about 55% of our energy.

Total World Electricity Generation by Fuel (2008):



Source: *IEA 2008* *Other includes solar, wind, combustible renewables, geothermal & waste


Stack
Coal supply
Electricity
Conveyor
Boiler
Steam turbine
Generator
Pulveriser/Mill
Substation/
transformer
Condenser
Ash systems
Water purification

The Bad

The Bad

•Mining coal causes water pollution and hurts ecosystems.

•Criteria air pollutants from combusting coal are:
CO_2, SO_2, NO_2, and particulate matter known as fly ash. These pollutants rise into the air with the flue gases.

•Toxins include varying concentrations of:
Arsenic, Beryllium, Boron, Cadmium, Chromium, Cobalt, Lead, Manganese, Mercury, Selenium, Strontium, Thallium, Uranium, Vanadium, Dioxins and Polycyclic Aromatic Hydrocarbons.

Mining Mountains

How mountaintop mining is done and its effects on the environment.

THE PROCESS

1 Trees are clear-cut, and explosives are used to loosen the rock and topsoil.

2 Huge shovels dig into the topsoil, and trucks start hauling it away.

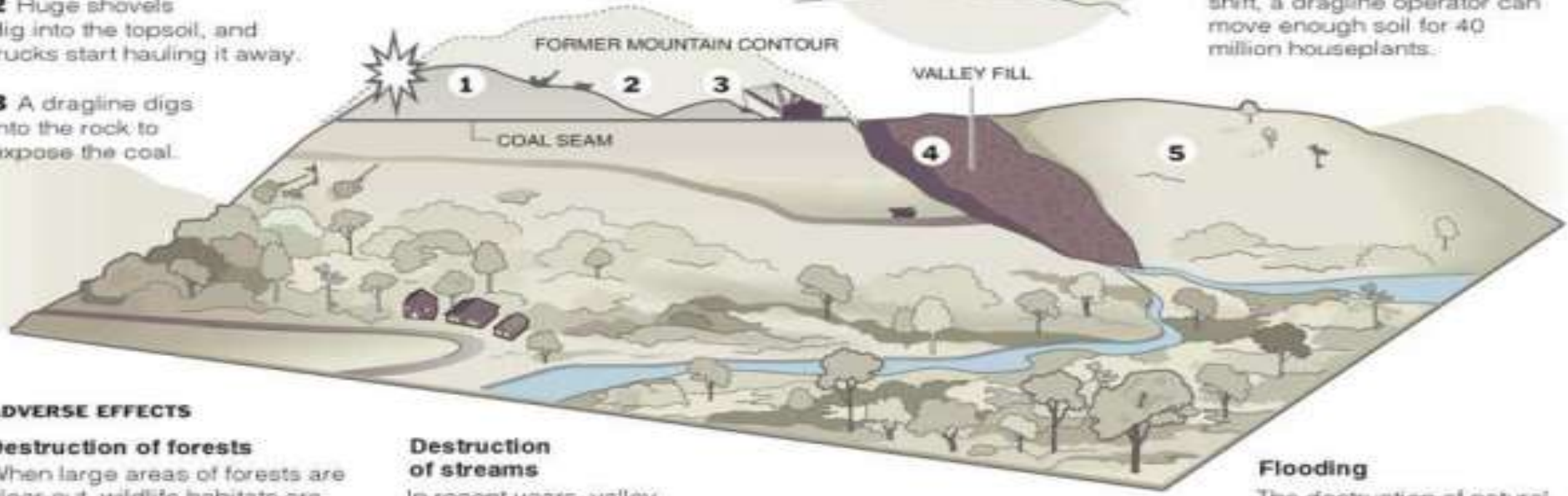
3 A dragline digs into the rock to expose the coal.

4 The draglines and 250-ton trucks dump the topsoil and rock into areas called valley fills.

5 Coal companies are supposed to reclaim land, but native trees have trouble growing on disturbed topsoil.

Giant earthmovers

In the last decade, the scope and scale of mountaintop mining has escalated with dragline use. These machines can weigh up to 8 million pounds and stand as tall as a 20-story building. In an 8-hour shift, a dragline operator can move enough soil for 40 million houseplants.



ADVERSE EFFECTS

Destruction of forests

When large areas of forests are clear-cut, wildlife habitats are destroyed. Wildlife and plantlife become more vulnerable to predatorial species.

Destruction of streams

In recent years, valley fills have buried or damaged 1,200 miles of streams.

Blasting

Explosions can cause damage to home foundations and wells.

Flooding

The destruction of natural streams by valley fills and the loss of vegetation can cause flooding.

Sources: Arch Coal Inc., West Virginia Department of Environmental Protection, Ohio Valley Environmental Coalition, Natural Resources Defense Council

Alisa Nance/The New York Times

The Bad

Before

After

The Bad

• Fly ash is the residuals from coal combustion that can fly out of the stack as air pollution, unless properly controlled.

• Approximately 50 to 60 million tons of this fly ash are produced each year in the United States as a byproduct of coal combustion.

•Approximately 10% of the mass of coals burned in the U.S. Consists of unburnable material that becomes ash, so the concentration of trace elements in coal ash is approximately 10 times the concentration in the original coal.

The Bad

- Fly ash may contain higher levels of contaminants than the bottom ash so polluters will mix the two to bring the levels of contaminants within the range to qualify as nonhazardous waste.

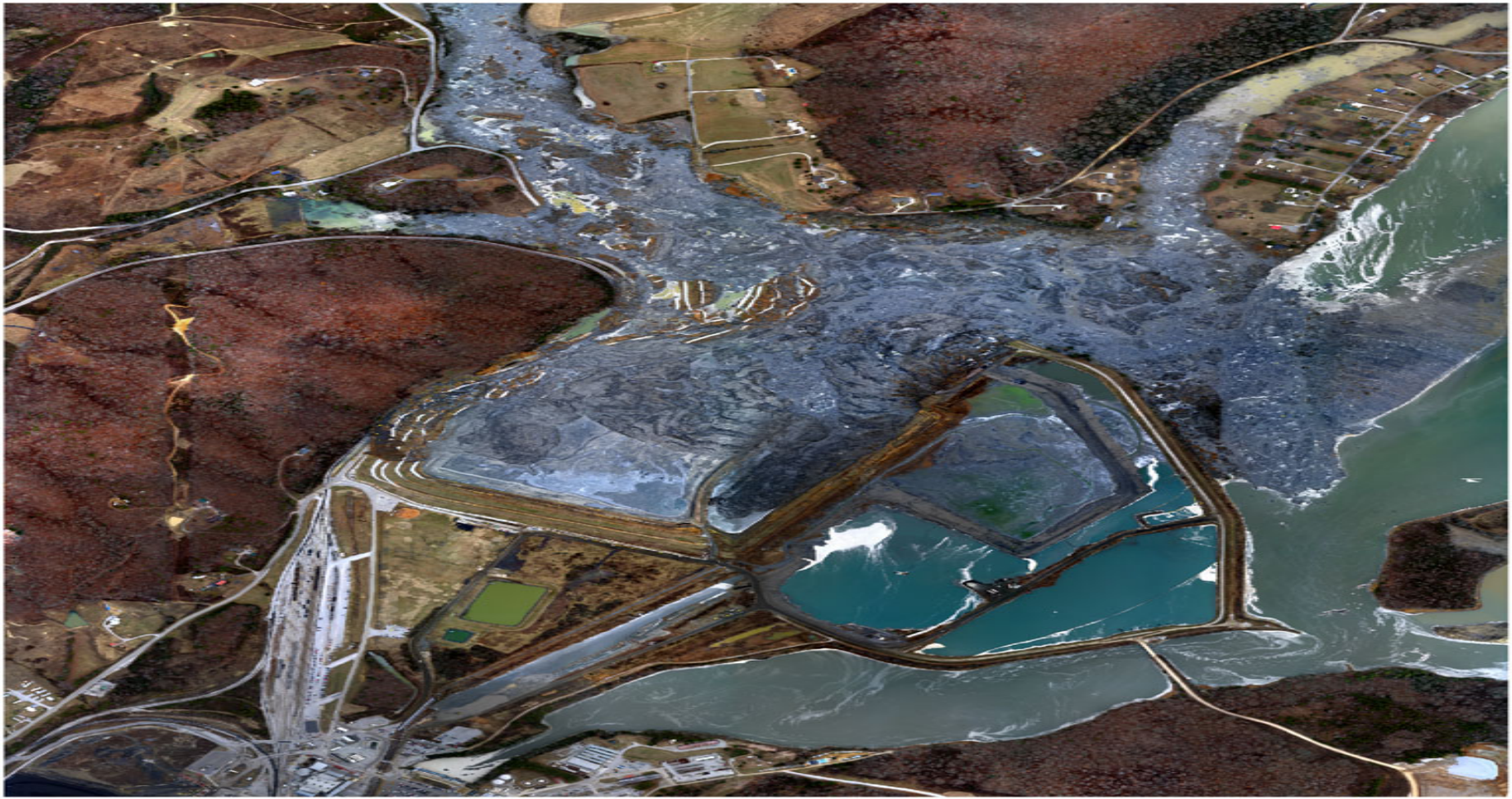
- The EPA estimates that 95 to 99% of particulate pollutants can be removed from air emissions caused by coal combustion.

- 40% of fly ash is recycled and used in products such as: Portland cement, Structural fill, Waste solidification, Soil stabilization, Road base, Geopolymers, Roofing tiles, & Paints

The Bad

In 2008 at the Kingston, TN power plant, a fly ash retention pool had its earthen dam break open releasing 2.6 million cubic yards of slurry (fly ash and water) into the Emory river which leads to the Tennessee river.

Aerial Image Of Kingston Ash Slide 12/23/08



N

0 250 500 1,000 1,500 2,000
Feet

Tennessee Valley Authority
OE&R - ER&S
Geographic Information and Engineering

The Bad

•Much of the fly ash recovered from Kingston, TN was shipped by train to Arrowhead landfill in Perry County, AL.

•That land fill has since filed for bankruptcy in January 2009.

• On June 21, 2010, a lawsuit was filed on behalf of 64 Perry County residents against the companies operating the landfill. The lawsuit contends the landfill is violating environmental rules and asks that the operators be barred from continuing to harm the residents who claim have been harmed by the odor, noise, and pollution from negligent management of the landfill.

The Ugly

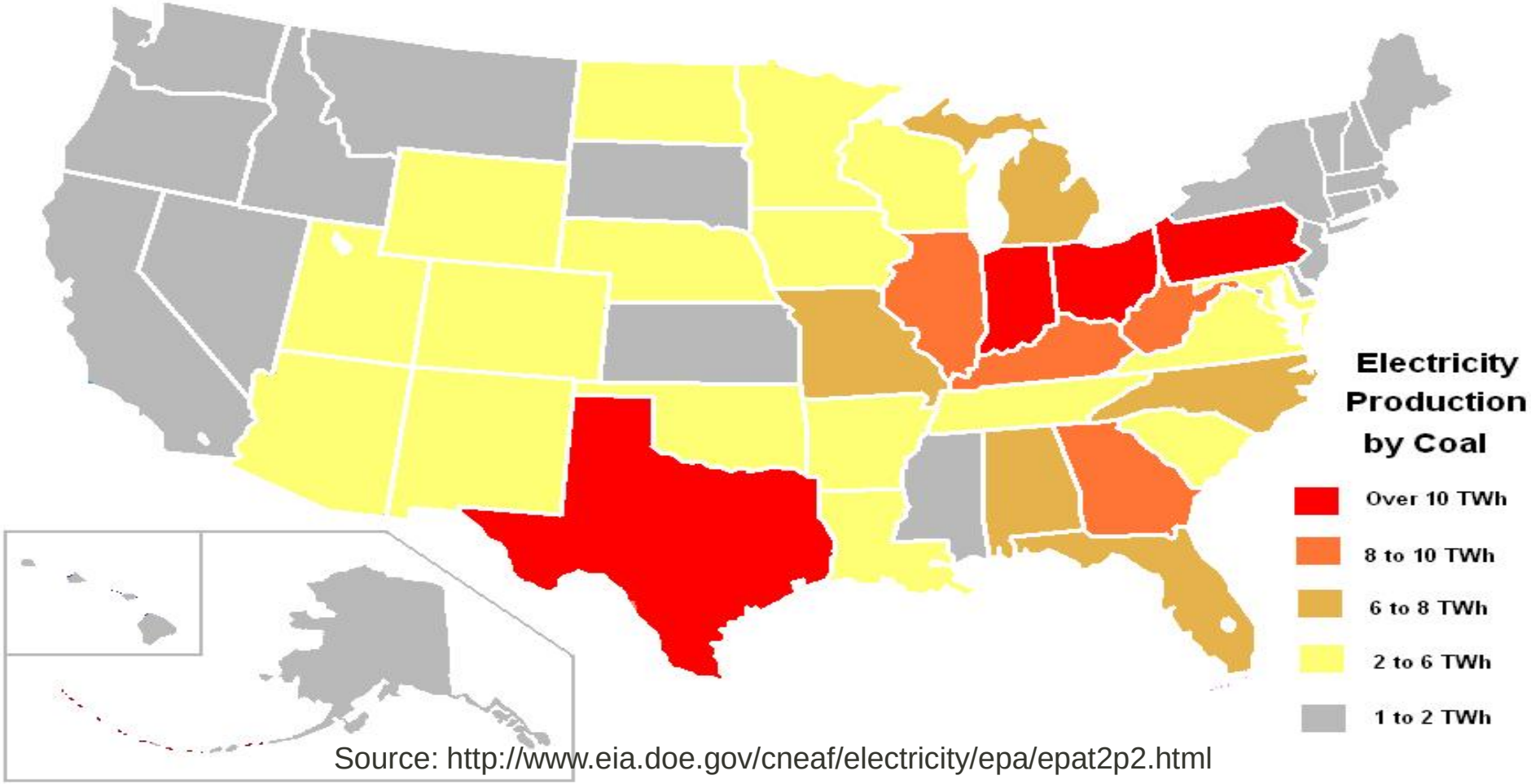
Here's a ranking of total amount of electricity each state produced from coal in 2005:

Rank	State	# of Plants	Total Capacity (MW)	Power Prod. (GWh)
1	*Texas*	20	21,238	148,759
2	Ohio	35	23,823	137,457
3	Indiana	31	21,551	123,985
4	Pennsylvania	40	20,475	122,093
5	Illinois	32	17,565	92,772
6	**Kentucky**	**21**	**16,510**	**92,613**
12	***Alabama***	**11**	**12,684**	**70,144**
50	***Vermont***	**0**	**0**	**0**

Source: http://www.eia.doe.gov/cneaf/electricity/epa/epat2p2.html

Distribution of Coal-Fired Generation in the U.S.

This map shows the distribution of coal-fired generation in the United States in July 2006.[1]



Source: http://www.eia.doe.gov/cneaf/electricity/epa/epat2p2.html

The Ugly

Out of the top 86 dirtiest U.S. coal-fired power plants in 2006, in terms of SO2 emissions, Alabama had 4 on the list:

Rank	Plant Name	State	Capacity	SO2 Emissions	SO2 Rate
1	R. Gallagher	IN	600 MW	50,819 tons	40.38 lb/MWh
2	Muskingum River	OH	1529 MW	122,984 tons	32.78 lb/MWh
3	Warrick	IN	755 MW	92,919 tons	32.69 lb/MWh
18	E.C. Gaston	AL	2013 MW	130,494 tons	22.91 lb/MWh
32	Gorgas	AL	1417 MW	81,268 tons	19.53 lb/MWh
33	Greene County	AL	568 MW	37,863 tons	18.99 lb/MWh
84	Colbert Fossil Plant	AL	1350 MW	39,942 tons	10.41 lb/MWh

Source: http://www.eia.doe.gov/cneaf/electricity/epa/epat2p2.html

The Ugly

State Cancer Deaths List (2009):

RANK	STATE	DEATHS PER 100,000 POPULATION
1	**Kentucky**	**225.1**
2	Louisiana	221.1
3	West Virginia	220.6
4	Mississippi	218.4
5	Tennessee	215
6	Arkansas	213.3
7	**Alabama**	**211.4**
50	Utah	144.7
Average	**United States**	**192.6**

Source: http://www.eia.doe.gov/cneaf/electricity/epa/epat2p2.html

The Ugly

A study of Texas school district data and industrial mercury release data shows a statistical link between pounds of mercury released and autism rates in children.

•For every 1,000 pounds of mercury released by industrial sources in Texas into the environment in 1998, there was a corresponding 2.6 percent increase in autism rates in the Texas school districts in 2002.

•For every 1,000 pounds of mercury released by Texas power plants in 1998, there was a corresponding 3.7 percent increase in autism rates in Texas school districts in 2002.

•Autism prevalence diminished 1 percent to 2 percent for every 10 miles from the source.

MERCURY POISONING AND AUTISM

It isn't a coincidence.

SYMPTOMS OF AUTISM IN CHILDREN

Loss of Speech
Social Withdrawal
Reduced Eye Contact
Repetitive Behaviors
Hand-flapping, Toe-walking
Temper Tantrums
Sleep Disturbances
Seizures

SYMPTOMS OF MERCURY POISONING IN CHILDREN

Loss of Speech
Social Withdrawal
Reduced Eye Contact
Repetitive Behaviors
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Seizures

Control

- Flue gas desulfurization systems are very popular in power plants and use wet or dry scrubbers to remove pollutants from the gas stream.

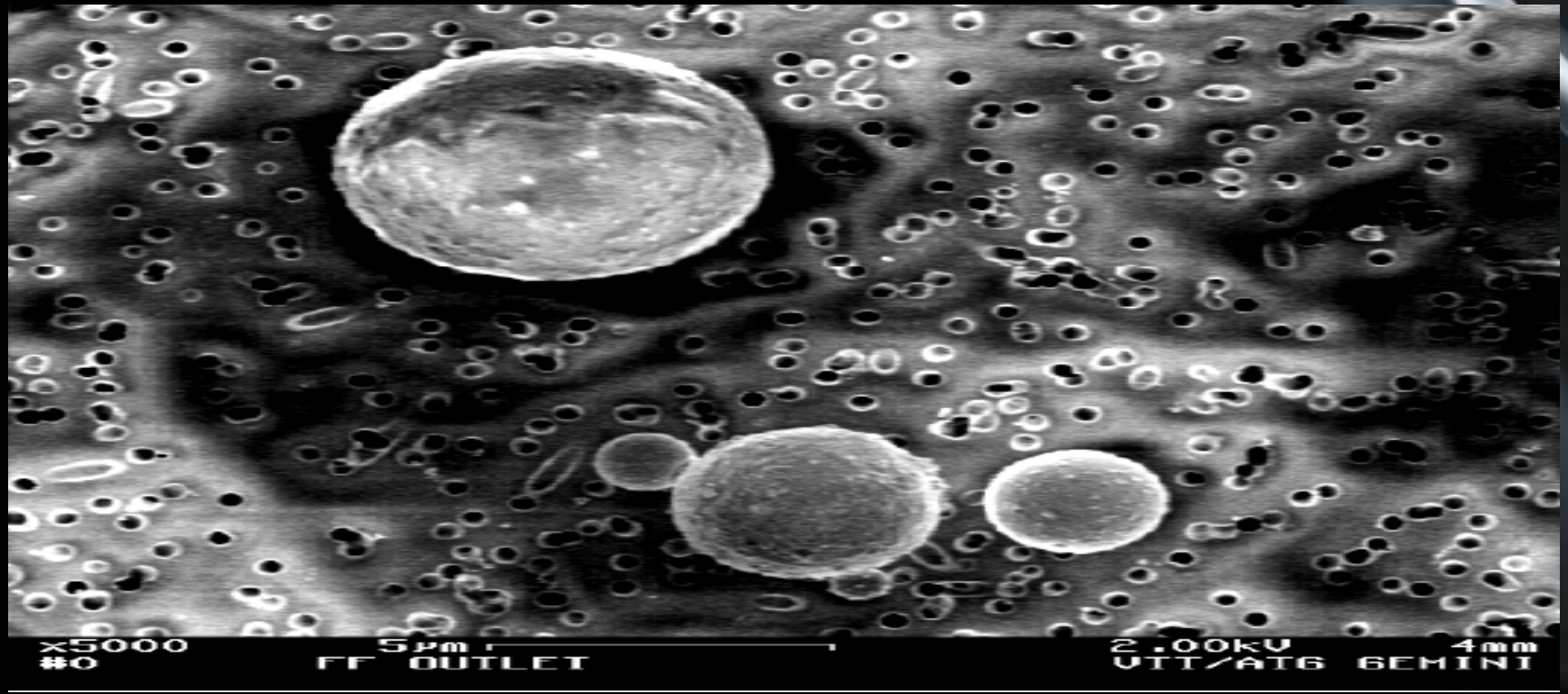
- Most FGD systems employ two stages of scrubbing. One for fly ash removal and the other for SO_2 removal.

- Other control devices for fly ash removal include Fabric Filters, Electrostatic Precipitators, and Cyclones.

- All the control devices are very effective at reducing emissions from coal combustion

Control

Fly ash collected in fabric filter with 0.4 µm openings



Lillieblad L. and Wieslander, P., "PM2.5 and Mercury Emissions From a High Ratio Fabric Filter After a Pulverized Coal Fired Boiler," ALSTOM Power Sweden, Paper #200

Control

So, why do we still have problems with fly ash emissions?

•The Clean Air Act Amendments of 1977, among other things, established a permitting program to insure that every new plant meets the air quality standards established by the CAA of 1970.

•However, existing power plants were exempted from the permit program until they underwent “major modifications.”

• Currently only about 50% of coal burning power plants have adequate pollution controllers installed.

Summary

- Mining coal can damage the environment.
- Fly ash is emitted from coal combustion.
- Captured fly ash can spill from its containers and damage the environment before it is able to be recycled.
- Emissions can be controlled but policy needs to be more stringent to be effective.
- Control mechanisms include scrubbers, electrostatic precipitators, fabric filters, and cyclones.
- There are links between coal combustion emissions with cancer deaths and autism in children.


QUESTIONS

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