EARTHJUSTICE
Because the earth needs a good lawyer






Waste Deep

Filling Mines with Coal Ash Is Profit for Industry, But Poison for People

EARTHJUSTICE

Because the earth needs a good lawyer

116 John Street

Suite 3100

New York, NY 10038.

Credits:

Writers: Martha Keating, Lisa Evans,
Ben Dunham, and Jeff Stant

Design: Patricia Gunn

Printing: McArdle Printing Company, Inc.

www.earthjustice.org/coalash

executive summary





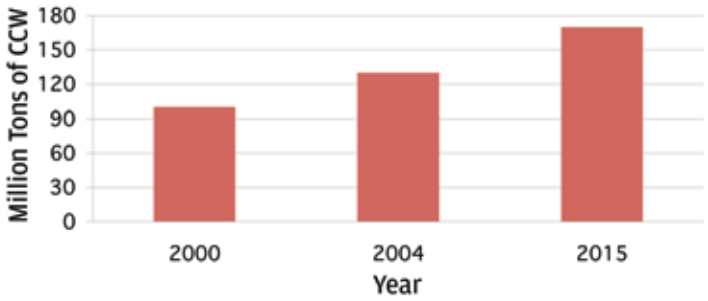

Disposal of coal combustion waste in coal mines is poisoning streams and drinking water supplies across the country. The solid waste generated by burning coal in power plants is the second largest industrial waste stream in the United States. In fact, enough coal combustion waste (CCW) is generated each year in the United States to fill a train stretching from Washington, D.C. to Melbourne, Australia. With no federal standards for disposal of coal combustion waste, more commonly referred to as coal ash, companies often dump it in locations that allow numerous toxic constituents to leach, or dissolve, out of the waste and into nearby streams, ponds, rivers, lakes and other waters. From New Mexico to North Carolina, water contaminated by coal combustion waste has poisoned communities and killed fish and livestock.

In December 2008, a dike constructed of ash for a coal ash sludge impoundment failed at the Tennessee Valley Authority's Kingston Fossil Plant in Harriman, Tennessee. The failure caused the release of over 1 billion gallons of toxic coal ash sludge over 300 acres, poisoning streams and rivers with unsafe amounts of arsenic, lead, chromium, thallium, and other toxic metals. Despite the risk of life-threatening disasters like the one that occurred in Tennessee, and the extensive, documented damage to human health and the environment by coal ash throughout the U.S., there are no specific federal regulations governing the disposal of this waste. In the absence of federal regulations, many states allow dumping of coal ash into unlined mine pits, where the waste's toxic constituents can migrate unimpeded into groundwater. Dumping coal combustion waste into mines is especially dangerous because mining often creates conditions that allow for more rapid contamination of adjacent groundwater. Based on mine disposal rates in Pennsylvania, West Virginia, Indiana, Ohio, Illinois, Texas, North Dakota, and New Mexico, plus conservative estimates of mine disposal in seven other coal basin states, we estimate that approximately 24 to 25 million tons of CCW, or 20 percent of generation, are minefilled each year.

Under these conditions, the waste's toxic contaminants, including arsenic, cadmium, chromium, lead, selenium and thallium, can readily pollute streams and drinking water. These chemicals can result in a number of health effects in humans, including neurological damage, cancer, and reproductive failure, as well as widespread ecosystem damage.

Federal regulations are needed to ensure that essential safeguards are in place before coal combustion waste is disposed of in coal mines. These safeguards must ensure that companies reveal the toxicity of the waste they are dumping, identify sources of groundwater and surface water that are susceptible to contamination from the dumping, and prohibit the disposal of waste directly into groundwater. Federal regulations must also require long-term, comprehensive monitoring for pollution from the dumping, and ensure that mine owners are held financially responsible for clean up. Because state regulations uniformly fail to require these safeguards, the U.S. Environmental Protection Agency must immediately act to establish federal minimum standards that ensure full protection of human health and the environment in coalfield communities.

Figure 1. Increases in Coal Combustion Waste Forecast through 2015



U.S. EPA, Clean Air Markets Division. Memorandum to the Docket entitled "Economic and Energy Analysis for the Proposed Interstate Air Quality Rulemaking. January 28, 2004."

A mountain of coal combustion waste (foreground) on the Navajo Nation Reservation, Fruitland, New Mexico, generated by the Four Corners Power Plant

Waste Deep: Filling Mines with Coal Ash Is Profit for Industry, but Poison for People

A Widespread and Deadly Waste

Burning coal produces over 129 million tons *each year* of coal combustion waste (CCW), the equivalent of 1 million fully loaded railroad cars stretching from Washington, D.C. to Melbourne, Australia.[1] Coal ash is largely made up of ash and other unburned materials that remain after the coal is burned in a power plant to generate electricity. These industrial wastes also include the particles captured by pollution control devices installed to prevent air emissions of particulate matter (soot) and other gaseous pollutants from the smokestack. In addition to burning coal, some power plants mix coal with other fuels and wastes, including a wide range of toxic or otherwise hazardous chemicals, such as the residue from shredded cars (a potential source of PCBs), oil combustion waste (often high in vanadium), railroad ties, plastics, tire-derived fuel and other materials.[2] Burning hazardous materials at power plants introduces additional toxic chemicals into the waste stream. As demand for electricity increases and regulations to reduce air emissions from power plants are enforced, the amount of CCW is expected to increase year after year (see Figure 1, top left).

CCW is significantly different from coal itself. As the coal is burned, its volume is reduced by two-thirds to four-fifths, concentrating metals and other minerals that remain in the ash. Elements such as arsenic, chlorine, copper, mercury, selenium, zinc, and numerous other dangerously toxic contaminants are found in much higher concentrations in the ash compared to the coal.[3] These substances are poisonous and can cause cancer or damage the nervous systems and other organs, especially in children. The thousands of tons of chemicals disposed of in CCW each year are second in quantity only to mining waste (see Figure 2, opposite).

A chemical analysis of southwestern subbituminous coal illustrates the differences between the coal before it was burned and the fly ash and bottom ash after combustion.[4] As shown in Figures 3a and 3b (opposite), the concentration of metals in the coal ash is at least 4 to 5 times higher than in the original coal. For barium, the concentration in the ash is 42 times higher than in the coal.

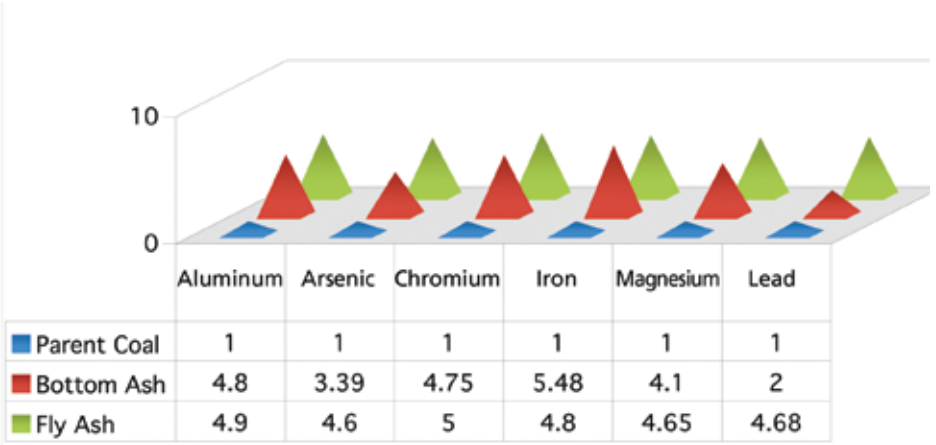
No good deed goes unpunished: How better air pollution controls make coal combustion waste more dangerous

CCW is becoming increasingly toxic. As air pollution control regulations are implemented, more particulates and metals are captured in the ash instead of being emitted from

the smokestack. In a 2006 report on CCW, U.S. Environmental Protection Agency found that when activated carbon injection was added to a coal-fired boiler to capture mercury emissions, the resulting waste leached selenium and arsenic at levels sufficient to classify the waste as "hazardous" under the Resource Conservation and Recovery Act (RCRA).[5] Specifically, EPA found that arsenic leaches as high as 100 times its maximum contaminant level (MCL) for drinking water and selenium leaches at levels up to 200 times its MCL. EPA concluded that the tendency of coal ash from these types of boilers to leach toxic arsenic and selenium should require site-specific evaluation of CCW disposal sites.[6] No such site-specific evaluation is currently required at any mine disposal sites.

In a follow-up study in 2007, EPA tested the leaching characteristics of solid waste from a boiler with a wet scrubber for sulfur dioxide and mercury control. EPA found that the CCW also leached metals at levels significantly higher than their MCLs.[7] These results are shown in Table 1. In addition to the metals shown in Table 1, the CCW leached large amounts of boron and barium above RCRA's hazardous waste threshold (100 times the MCL). Levels of concern for molybdenum, cadmium, and lead were also found. As shown in Table 2, all of the pollutants found in CCW can have multiple adverse effects on human health. Given the tendency of CCW to leach metals at highly toxic levels, there is clearly the need for scrutiny of current mine-filling policies.

Figure 3a. Metal Concentrations Increase after Coal Is Burned[4]



Concentration in Ash Relative to Parent Coal

Figure 2. Tons of Chemicals in Waste Generated by Various Industries - On and Off Site Disposal (U.S. EPA 2006 Toxics Release Inventory)

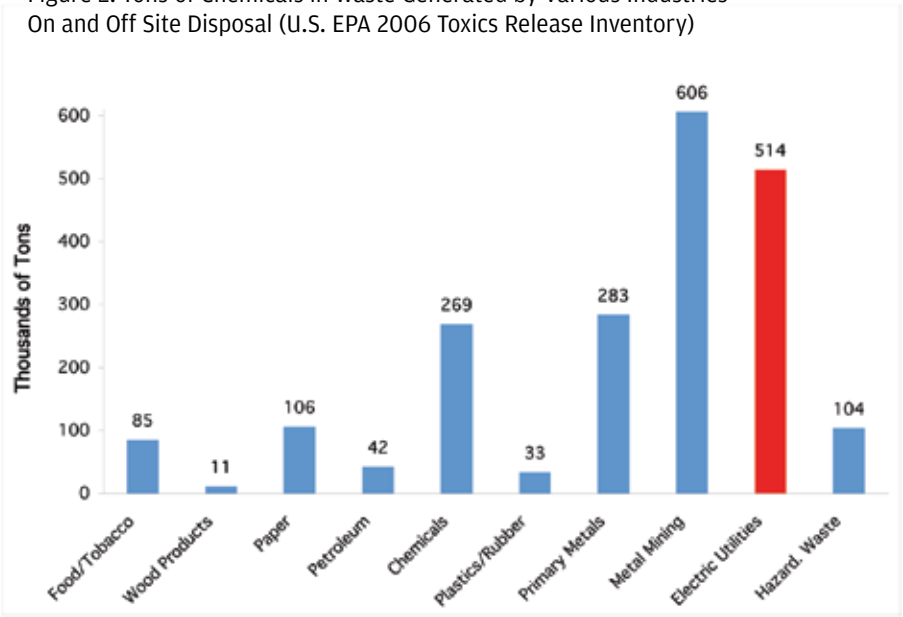
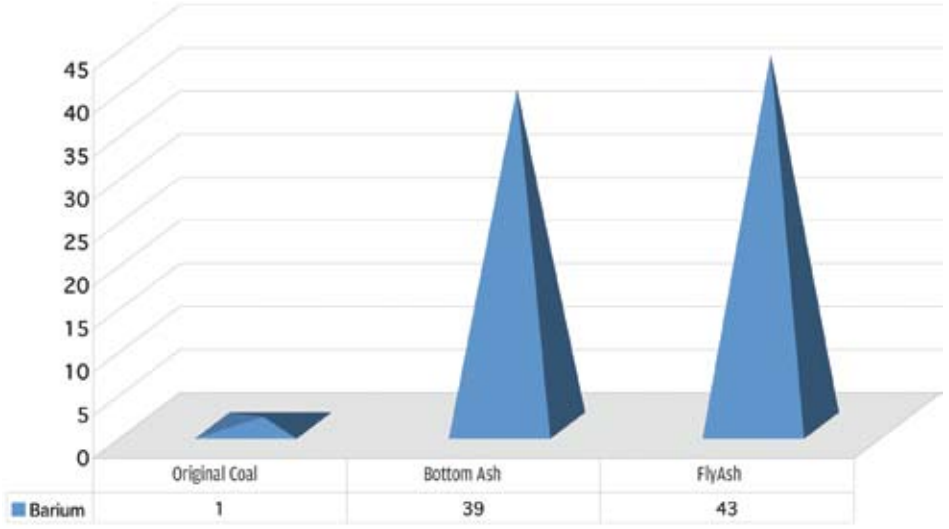


Figure 3b. Increase in Barium Concentration after Coal is Burned[4]



Barium Concentration in Ash Relative to Parent Coal

Children are most vulnerable to CCW health risks.

Table 2. Human Health Effects of Some Coal Combustion Waste Pollutants

Aluminum	Lung disease, developmental problems
Antimony	Eye irritation, heart damage, lung problems
Arsenic	Multiple types of cancer, darkening of skin, hand warts
Barium	Gastrointestinal problems, muscle weakness, heart problems
Beryllium	Lung cancer, pneumonia, respiratory problems
Boron	Reproductive problems, gastrointestinal illness
Cadmium	Lung disease, kidney disease, cancer
Chromium	Cancer, ulcers and other stomach problems
Chlorine	Respiratory distress
Cobalt	Lung/heart/liver/kidney problems, dermatitis
Lead	Decreases in IQ, nervous system, developmental and behavioral problems
Manganese	Nervous system, muscle problems, mental problems
Mercury	Cognitive deficits, developmental delays, behavioral problems
Molybdenum	Mineral imbalance, anemia, developmental problems
Nickel	Cancer, lung problems, allergic reactions
Selenium	Birth defects, impaired bone growth in children
Thallium	Birth defects, nervous system/reproductive problems
Vanadium	Birth defects, lung/throat/eye problems
Zinc	Gastrointestinal effects, reproductive problems

Source: ATSDR ToxFAQs, available at www.atsdr.cdc.gov/toxfaq.html

Table 1. Results of Leaching Tests for Coal Combustion Waste from Coal-fired Power Plant with Multi-pollutant Air Pollution Controls[7]

Pollutant	Metal Concentration in Leachate Exceeds Maximum Contaminant Level by:
Arsenic	400×
Antimony	33×
Chromium	40×
Thallium	150×
Mercury	12.5×
Selenium	60×

EPA's own analyses of how CCW behaves in unlined disposal sites predict that some metals will migrate and contaminate nearby groundwater to levels extremely dangerous to people. In 2007, EPA published a draft risk assessment that found extremely high risks to human health from the disposal of coal ash in waste ponds and landfills.[8] Figure 4 (opposite) compares EPA's findings on the cancer risk from arsenic in coal ash disposed in waste ponds to several other cancer risks, along with the highest level of cancer risk that EPA finds acceptable under current regulatory goals. According to EPA, the excess cancer risk for children drinking groundwater contaminated with arsenic from CCW disposal in unlined ash ponds is estimated to be as high as 9 in 1,000— 900 times higher than EPA's own goal of reducing cancer risks to less than 1 in 100,000.[9] In fact, in calculating this risk estimate for ash ponds EPA assumed that the ash pond would be above the local water table. Because CCW in mines is in direct contact with the groundwater, residents living near minefilling sites could potentially be at even higher risk.

Damage to human health and the environment from coal combustion waste

For decades, scientists have documented environmental damage at CCW disposal sites. Impacts include the leaching of toxic substances into soil, drinking water, lakes and streams; damage to plant and animal communities; and accumulation of toxins in the food chain.[10,11,12]

- At more than 70 sites in the U.S. there is ample evidence that coal ash has polluted ground and surface waters.[13]
- According to EPA, coal ash has contaminated water in 24 states.[14]
- Hundreds of cattle and sheep were killed and many families sickened in northern New Mexico by ingesting water poisoned by coal combustion waste.[15]
- Fish consumption advisories have been issued in Texas and North Carolina for

water bodies contaminated with selenium from CCW disposal sites and entire fish populations have been destroyed.[16,17]

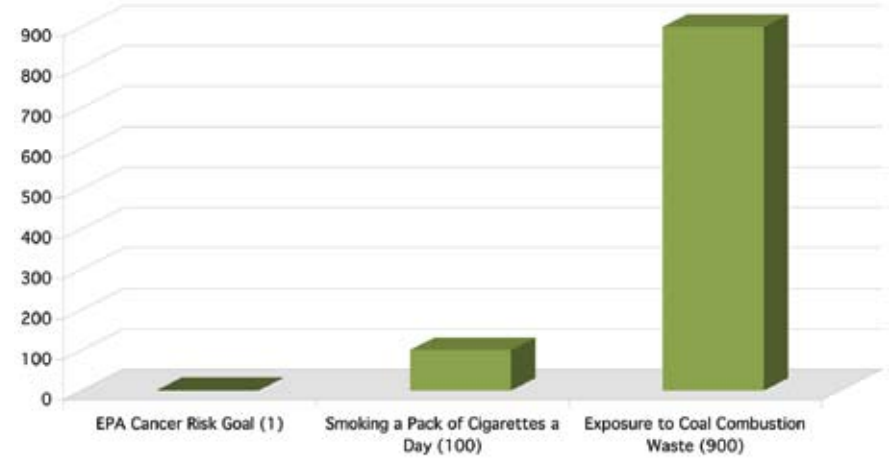
- Studies in South Carolina have documented developmental, physiological, metabolic, and behavioral abnormalities and infertility in nearly 25 species of amphibians and reptiles inhabiting wetlands contaminated by CCW.[18]

- Highly alkaline ash and scrubber sludge that dries out in uncovered mine pits becomes airborne on windy days. The high pH of the ash, the extremely small size of the particles, and the toxic metals contained in the ash all present health hazards to nearby communities.[19,20,21,22]

Down the Hatch: Coal Combustion Waste in Mines

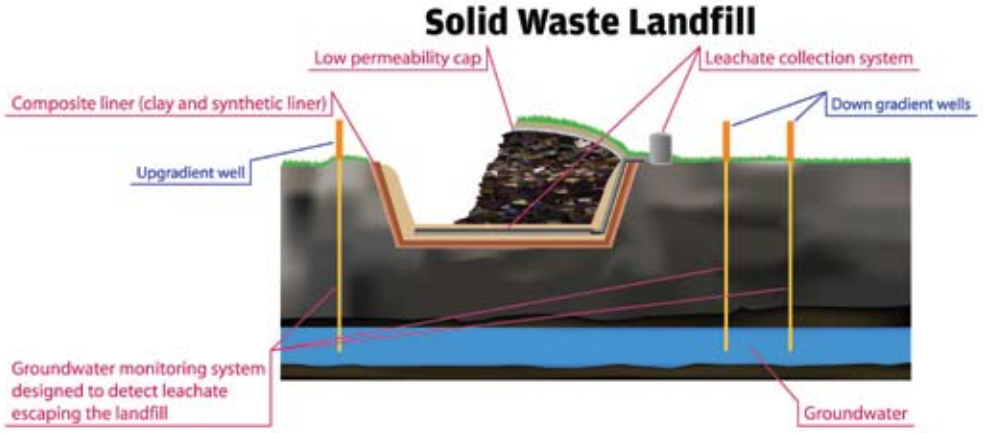
Each year, approximately 25 million tons of coal ash are placed in active and abandoned mines without basic safeguards to protect health and water resources. Under pressure from electric utilities, many states have wrongly defined the dumping of CCW in coal mines as a "beneficial use" of an industrial waste and exempted the practice from all solid waste regulations.[23] If they exist at all, beneficial use regulations tend to apply very few protections. Consequently, enormous quantities of toxic industrial waste are being dumped directly into groundwater without any monitoring or clean up requirements.

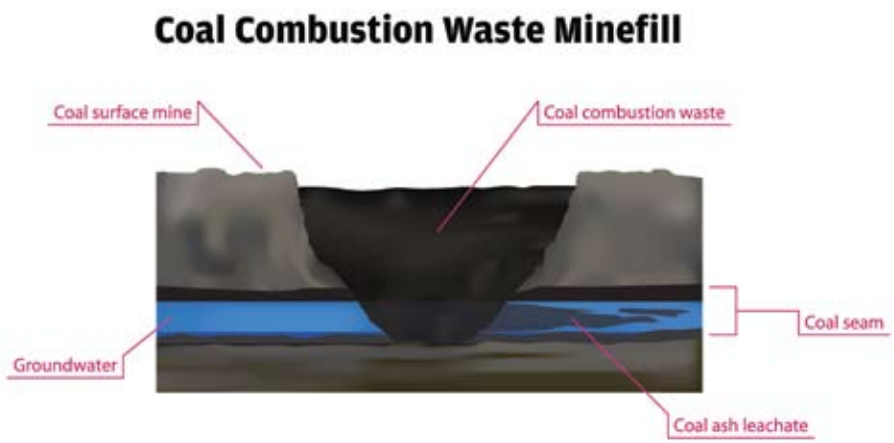
Figure 4. EPA Estimate of Cancer Risk from Arsenic in Coal Combustion Waste.



Source: EPA. Human Health and Ecological Risk Assessment of Coal Combustion Wastes (draft), 2007.

Figure 5. Typical Minefill vs. Solid Waste Landfill. Diagram compares a typical solid waste landfill and coal combustion waste minefill. Common landfill controls (e.g., liners, leachate collection systems, and monitoring wells) are usually lacking at CCW minefills. (Graphics courtesy of Matt Lau)





Springdale Mine Pit, Tamaqua, Pennsylvania. Photo above shows dust containing CCW rising from the mine. The immense Springdale Pit measures 700 feet deep, 1,500 feet wide and 3,000 feet long.

Fast-tracking dangerous pollution: How minefilling increases the risk of harm from coal combustion waste

The unique geologic characteristics of mines maximizes the risk of contamination from coal ash dumping. Mining breaks up solid rock layers into small pieces, called spoil. Compared to the flow through undisturbed rock, water easily and quickly infiltrates spoil that has been dumped back into the mined-out pits. Fractures from blasting become underground channels that allow groundwater to flow rapidly offsite. Because mines usually excavate aquifers (underground sources of water), the spoil fills up with groundwater. Unlike engineered landfills, which are lined with impervious membranes (clay or synthetic) and above water tables by law, coal ash dumped into mine pits continually leaches its toxic metals and other contaminants into the water that flows through and eventually leaves the site. See Figure 5.

How much coal combustion waste is dumped in mines?

In 2006, the American Coal Ash Association claimed that 43 percent of nearly 125 million tons of CCW was "recycled",[24] leaving about 71 million tons of coal ash to be disposed of, much of which ended up in unlined and unmonitored waste ponds, landfills and mines. While industry estimates that the amount of CCW being disposed in active or abandoned mines is only about 1.5 million tons, this is a gross underestimate.[25] Our conservative estimate is that at least 4 times that amount, about 6 million tons, is dumped every year in Pennsylvania mines alone.[26] Based on mine disposal rates in Pennsylvania, West Virginia, Indiana, Ohio, Illinois, Texas, North Dakota, South Dakota and New Mexico, plus conservative estimates of mine disposal in eight other coal basin states, we estimate that **approximately 24 to 25 million tons of CCW, or 20 percent of generation, are minefilled each year**.

One reason for this discrepancy in estimates is that industry and state regulators are hiding CCW dumping in mines behind the labels "beneficial use" or "recycling." Yet minefilling is far from beneficial use or recycling. In reality, these mines are open dumps and are operating under state rules that are far less protective than requirements for disposing of household trash.

It is difficult to convey the sheer scale of these minefills. In the pictures to the left is the 700-foot deep Springdale Pit in Tamaqua, Pennsylvania. The pit is 3,000 feet long and 1,500 feet wide, large enough to fit nearly 80 football fields. Before an environmental group appealed the permit for this site, Pennsylvania regulators had issued a permit that would have allowed up to 59 million tons of CCW and sludge to be dumped into this one giant pit. The Springdale Pit has only a few groundwater monitoring wells for the entire operation.

The scale of the Springdale Pit is not an anomaly. In western Pennsylvania, the owners of the Champion Coal Refuse Disposal Site are seeking to mine waste coal for a new waste coal-burning power plant.[27] Their permit would authorize the dumping of up to 87 million tons of CCW on the mine site.[28] This

In northern New Mexico, two power plants together have disposed of about 100 million tons of coal in two surface coal mines about 10 miles apart, north and south, respectively, of the San Juan River.

amount of CCW is equivalent to 675,000 railroad cars of coal ash dumped on a site that is surrounded by people relying on private drinking water wells. Only two additional off-site monitoring wells were requested by local officials beyond the three to four required by the permit.[29]

In northern New Mexico, two power plants together have disposed of about 100 million tons of coal ash in two surface coal mines about 10 miles apart, north and south, respectively, of the San Juan River.[30]

Despite the immense size of these waste dumps, operators of mine disposal sites avoid nearly all of the safeguards required at much smaller municipal waste landfills, where predominantly household garbage is deposited. According to federal law, municipal waste landfills are subject to requirements for engineered liners and covers, extensive monitoring, corrective action standards, and financial assurance. Most CCW minefills are subject to *none* of these requirements.

Evidence of damage at coal combustion waste minefill sites

Serious contamination has been documented at numerous mine sites across the country where CCW has been dumped. In a multiyear study of 15 coal ash minefills in Pennsylvania, researchers found that CCW made the water quality worse at 10 of the 15 sites. At the remaining five sites, there was not enough monitoring data to determine whether adverse impacts were caused by the coal combustion waste. A review of the permits revealed that:

- Levels of contaminants, including aluminum, arsenic, cadmium, chloride, chromium, lead, manganese, nickel, selenium, and sulfate, increased in groundwater and/or surface water after coal ash was dumped in the mines.
- Contaminants increased from background concentrations (measured after mining) to levels hundreds to thousands of times above federal drinking water standards.

Coal ash minefill at the Navajo Mine, Navajo Nation Reservation, Fruitland, N.M. Photo credit: Bruce Gordon, EcoFlight

Piles of red FBC waste coal ash in an eastern Pennsylvania mine

McDermott Mine
Cambria County, PA

At the McDermott Mine, waste coal ash contaminated surface and groundwater with toxic levels of cadmium, selenium, sulfate, manganese and other pollutants. Billed as "alkaline addition" to clean up "preexisting pollution" from acid mine drainage, the Pennsylvania Department of Environmental Protection permitted the dumping of approximately 316,000 tons of CCW at the 73-acre surface mine from 1996-2004. The coal ash, however, failed to stop the acid mine drainage. Instead, pollution rose precipitously, rendering offsite water unfit for human consumption and forcing the abandonment of a spring used as a drinking water source.

Minefill operation in Pennsylvania.

After CCW disposal, cadmium and selenium appeared in the groundwater and surface water at levels toxic to humans and aquatic life. Neither of these contaminants was detected before ash disposal. Cadmium jumped to nearly 14 times the drinking water standard in groundwater and increased in surface water to nearly 4 times the drinking water standard and 76 times the water quality standard. Selenium, a pollutant that is extremely toxic to aquatic life, was measured at a seep at the property boundary at nearly 4 times the drinking water standard and more than 36 times the water quality standard. At a deep mine discharge 800 feet beyond the property boundary, selenium increased to levels exceeding water quality standards, with the highest measurement 14 times the standard. In addition to threatening human health, these toxic levels of cadmium and selenium are discharging in volumes of water exceeding 100 gallons per minute into a small stream that has limited ability to absorb this pollution.

Whether it's called "beneficial placement" or disposal, the minefilling of coal ash at the McDermott Mine demonstrates that contamination from ash can spread well beyond the boundaries of a mine in levels toxic to humans and aquatic life.

Disposing of CCW in mines without minimum safeguards is done for economic reasons above all else. Compared to disposal of these wastes in an engineered landfill, disposal of CCW in mines reduces the disposal cost by 89 to 95%.

- Pollution was found downstream from coal ash disposal areas and sometimes well outside the boundary of the mines.

When the cure is worse than the disease: Dumping coal combustion waste to treat acid mine damage threatens greater harm.

Promoters of minefilling in eastern states argue that dumping alkaline CCW into coal mines will neutralize the acidic runoff that results from mining. But the facts show that minefilling is not a solution to acid mine drainage. In Pennsylvania, in the majority of mines studied where CCW was "placed," acidity actually *increased* over time.[31] While the CCW remediated acid mine drainage *temporarily* in a few cases, in two-thirds of all the mines studied, the introduction of coal combustion waste resulted in more severe, long-term water quality contamination than had ever existed at these sites from the mining operation itself. Furthermore, as a practical matter, dumping large quantities of CCW directly into water tables in highly fractured sites under massive quantities of mine overburden makes the prospect of cleaning up resulting contamination far more daunting than halting leakages from conventional landfills and ash ponds.

Thus, rather than cleaning up the water, CCW disposal is increasing the total amounts of toxic metals in mines and generating more contamination from those metals than ever occurred from the acid mine drainage alone.

Who Benefits from Minefilling?

Special interest economics trump public health and the environment

Even when confronted with evidence of groundwater contamination and increasing toxicity of CCW, federal and state regulators and the coal mining industry continue to resist any changes to their waste disposal practices.

Disposing of CCW in mines without minimum safeguards is done for economic reasons above all else. Compared to disposal of these wastes in an engineered landfill, disposal of CCW in mines reduces the disposal cost by 89 to 95 percent.[32] Waste coal power plant operators claim that any imposition of safeguards would result in closure of their plants.[33] Proper disposal of the ash produced by FBC waste coal-burning plants in Pennsylvania alone would cost these operators more than $300 million per year.[34]

Lax regulation encourages CCW disposal in mines. This is poor public policy. Lack of minimum federal standards penalizes those power companies who manage their wastes responsibly.

The lack of standards also encourages corner-cutting in management of the wastes by mining companies seeking to sell more coal by offering to backhaul wastes generated by power producers. Unlike the financial assurance posted by landfills, mine bonds typically do not include funds for remediating groundwater contamination.[35] These bonds are released to the mine operators as soon as they have revegetated the mine surfaces, long before contamination from CCW is discovered. When contamination does occur, there is no money left to pay for cleanup. As a result, the true cost of management is shifted from power plants and mine operators to host communities and taxpayers who must pay for cleaning up wastes that will remain chemically active for decades and will threaten water resources in perpetuity.

Remining waste coal and the surge in FBC Power plants

Some states have actually encouraged industry practices that increase the risk of exposure to CCW disposed in mines. "Remining" at abandoned mine lands is booming in eastern coalfields. At remining sites, operators excavate waste coal piles and coal left from the previous mining operation. These materials are burned in a fluidized bed combustion ("FBC") plant. State regulators, particularly in Pennsylvania, actively encourage remining of waste coal on abandoned mine lands, which has led to the proliferation of FBC waste coal burning plants at mine sites.

The problem is that FBC plants produce huge amounts of waste – about 4 times more CCW per megawatt of electricity than conventional coal burning plants.[36] This is because the ash content of waste coals is 2 to 3 times higher than the parent coals, and because limestone is injected into the combustion process to capture emissions of sulfur dioxide. In Pennsylvania alone, FBC power plants produce only 8 percent of the electricity generated in the state, but ash from FBC plants makes up over 60 percent of the CCW produced by all of the state's power plants.[37] In Figure 6 (right), the amount of waste generated by a 585-MW FBC plant is compared to the amount of waste generated by a comparably sized pulverized coal (PC) boiler.[38] Over a 50-year operating lifetime, the FBC plant will produce over 100 million tons of waste (if the amount of coal burned in 2006 remains the same each year). The PC boiler, in contrast, will produce about one-third the solid waste, or about 31 million tons.

Figure 6. Millions of Tons of Waste Generated by an FBC Boiler over 50 Years

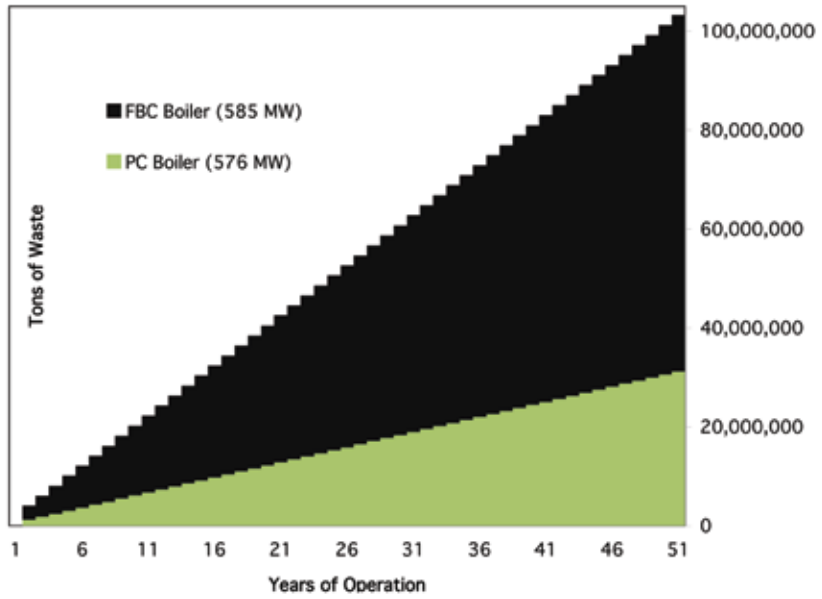
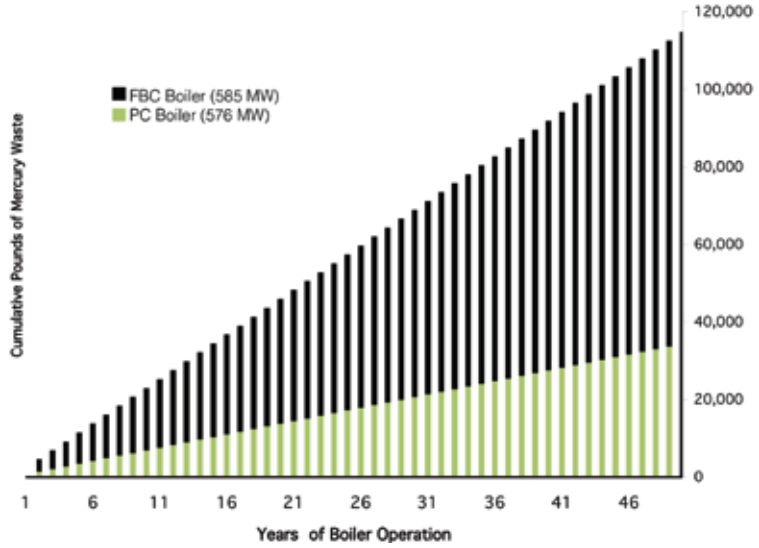


Figure 7. Tons of Mercury in Coal Combustion Waste from FBC Boiler over 50 Years



NEPCO Fluidized Bed Combustor, Schuylkill County, Pennsylvania.

Table 3. Proposed FBC Waste Coal Plants[39]

State	Plant Name	Megawatts
Pennsylvania	Schuylkill	41
Pennsylvania	Greene County	525
Pennsylvania	River Hill Power	290
Pennsylvania	Beech Hollow	250
Utah	Bonanza	110
West Virginia	Logan	Unknown
Wyoming	Two Elk 2	750

Even when confronted with evidence of groundwater contamination and increasing toxicity of CCW, federal and state regulators and the coal mining industry continue to resist any changes to their waste disposal practices.

In addition, the FBC coal combustion waste is highly concentrated with mercury. According to an industry survey of different coal types, waste bituminous coal contains 4 times more mercury than bituminous coal.[40] Figure 7 illustrates how much mercury will be contained in the coal combustion waste generated by the FBC and PC boilers, considering the amount of coal each will burn over 50 years. On an annual basis, the FBC boiler will generate 2,297 pounds of mercury in solid waste compared to 687 pounds in the CCW of the pulverized coal boiler. Notably, the huge quantities of ash, containing significantly more mercury and other toxins from the FBC boiler, will end up being dumped uncontrolled into an adjacent mine.

Table 3 (left) lists new FBC coal plants that are being built or planned at mine sites across the U.S. to burn waste coal. Since most waste coal FBC plants use mines as the dumpsites for their prodigious waste, communities near these plants must be vigilant about the threats posed by disposal of the FBC ash.

Who's Watching Out for You? Inadequate Regulation of Coal Combustion Waste

Despite the well-established toxicity of CCW, there are no adequate federal regulations in place to protect human health and the environment. The U.S. Environmental Protection Agency, which has the responsibility to ensure safe disposal of all solid and hazardous wastes, has acknowledged the need for protections, but has not issued any regulations for CCW. Since there are currently no federal standards, responsibility for protecting the public from exposure to CCW falls to the states, but their efforts to date have been grossly inadequate.

Is EPA regulating Coal Combustion Waste? No

Despite the toxicity of coal combustion waste, EPA decided in May 2000, under intense political pressure from the electric utility industry, not to regulate coal combustion waste as a "hazardous" waste.[41] EPA

Creating a Toxic Soup in Coal Mines

Promoters of minefilling fail to recognize that chemical conditions at these sites change over time, and that coal combustion waste contains high levels of many different heavy metals and other toxic trace elements, each of which can leach (or dissolve) into water under different chemical conditions, particularly when the water has a changing pH. pH is a logarithmic scale that indicates whether water is acidic (<7 pH units) or alkaline (>7 pH units). The more acidic the water, the lower its pH; the more alkaline, the higher its pH. Under alkaline, or high pH conditions, some metals do not dissolve in water, but others do. Under acidic conditions, the situation reverses; metals that were previously immobile when the site was alkaline now dissolve into the water. Minefill permits routinely ignore the tendency of some metals in ash to leach into water under neutral to higher pH and thus completely overlook the potential of CCW to contaminate groundwater. Examples of metals that leach into water as pH increases from acid into neutral ranges include arsenic, selenium, antimony, hexavalent chromium, vanadium, molybdenum and boron.[42] Multiple researchers have documented that a greater number of toxic trace elements leach in greater amounts in the changing pH of mine waters that varies from acidic to alkaline.[43,44,45] These findings have also been confirmed by monitoring data from ash minefills.[46]

Furthermore, at most eastern mines, there is much more acidity than can be buffered by the alkalinity of the ash. Eventually the ash loses all of its alkalinity and is acidified. As the pH of the ash falls and the water flowing through the ash becomes more acidic, metals such as cadmium, copper, lead, manganese, nickel, and zinc will leach into the water.[47] Ashes from a "fluidized bed combustor" (FBC), a type of power plant boiler that can burn practically any type of fuel, will become acidic in acid mine drainage without continual addition of alkaline material, with the result that the concentration of metals increases beyond the amounts originally contained in the acidic drainage.

The 1,798-MW San Juan Generating Station generates about 1 million tons of CCW each year. A large quantity of the CCW is disposed in the San Juan Coal Mine.

Credit: Mike Eisenfeld.

Other chemical reactions involving major constituents in mine water and ash such as iron and sulfate further complicate the picture, making it hard to predict when metals will leach based purely on the pH of the initial CCW. Thus, rather than cleaning up the water, CCW disposal is increasing the total amounts of toxic metals in mines and generating more contamination from those metals than ever occurred from the acid mine drainage alone.

San Juan Mine
Farmington, New Mexico

Forty million tons of coal combustion waste from Public Service New Mexico's (PNM) San Juan Generating Station have been dumped in the San Juan Mine since the late 1980s. The result is the poisoning of shallow groundwater and surface water in the Shumway Arroyo. Concentrations of lead, selenium, arsenic, cadmium, and boron have risen above drinking water standards in the shallow gravel aquifer underneath the arroyo. Sulfates in the aquifer have reached 55,000 milligrams per liter (mg/L) at the boundary of the mine, 220 times the secondary drinking water standard. The level of total dissolved solids in the groundwater, an indicator of all pollution dissolved in water, now exceeds 80,000 mg/L, 160 times the federal standard. The arroyo, previously a source of drinking water for area residents and their livestock, has been poisoned by coal ash. Now the water can only be used to fight fires. The polluted water from the Shumway Arroyo eventually flows to the San Juan River, a source of drinking water for thousands.

This is not the first time water has been severely contaminated by coal ash dumped by the San Juan Generating Station. In the 1970s, high levels of sulfate, pH, metals and other pollutants caused serious damage to neighboring ranchers. As a result, PNM paid millions of dollars to settle claims for cattle and sheep killed and families made sick by drinking the Shumway's contaminated water. In 1984, an EPA enforcement action forced PNM to line its ash disposal sites. Ironically, although PNM lined the ponds, the dumping of coal combustion waste in unlined sites accelerated when PNM subsequently required its primary coal supplier, the neighboring San Juan Mine, to backhaul more of PNM's coal ash to the mine's pits. Since 1987, the San Juan Mine has been filling more than 20 pits with CCW, ranging from a few acres to hundreds of acres in size. Large unlined pits, nearly 200 feet deep and 300 feet wide, are now filled with concentrated, battleship-sized tonnages of caustic fly ash and scrubber sludge. Because the pits are located above the arroyo, CCW continues to poison the groundwater.

The arroyo, previously a source of drinking water for area residents and their livestock, has been poisoned by coal ash. Now the water can only be used to fight fires. The polluted water from the Shumway Arroyo eventually flows to the San Juan River, a source of drinking water for thousands.

Rancher R.G. Hunt of Waterflow, NM holding one of hundreds of sheep that died after their drinking water was polluted by chemicals leaching from CCW dumped into the San Juan Mine.

State regulators, particularly in Pennsylvania, actively encourage remining of waste coal on abandoned mine lands, which has led to the proliferation of fluidized bed combustion waste coal burning plants at mine sites.

did conclude, however, that CCW causes significant damage if dumped without safeguards and promised to issue non-hazardous waste regulations (under Subtitle D of RCRA) for coal combustion waste landfills and waste ponds. Even though such guidelines cannot be enforced by EPA and fall short of what is needed to protect public health and the environment, EPA has failed to take any steps toward even this modest goal. EPA also concluded in 2000 that federal safeguards were needed for minefilling, particularly because of the potential for groundwater contamination.[48] Yet EPA has also failed to fulfill its promise to develop these regulations.

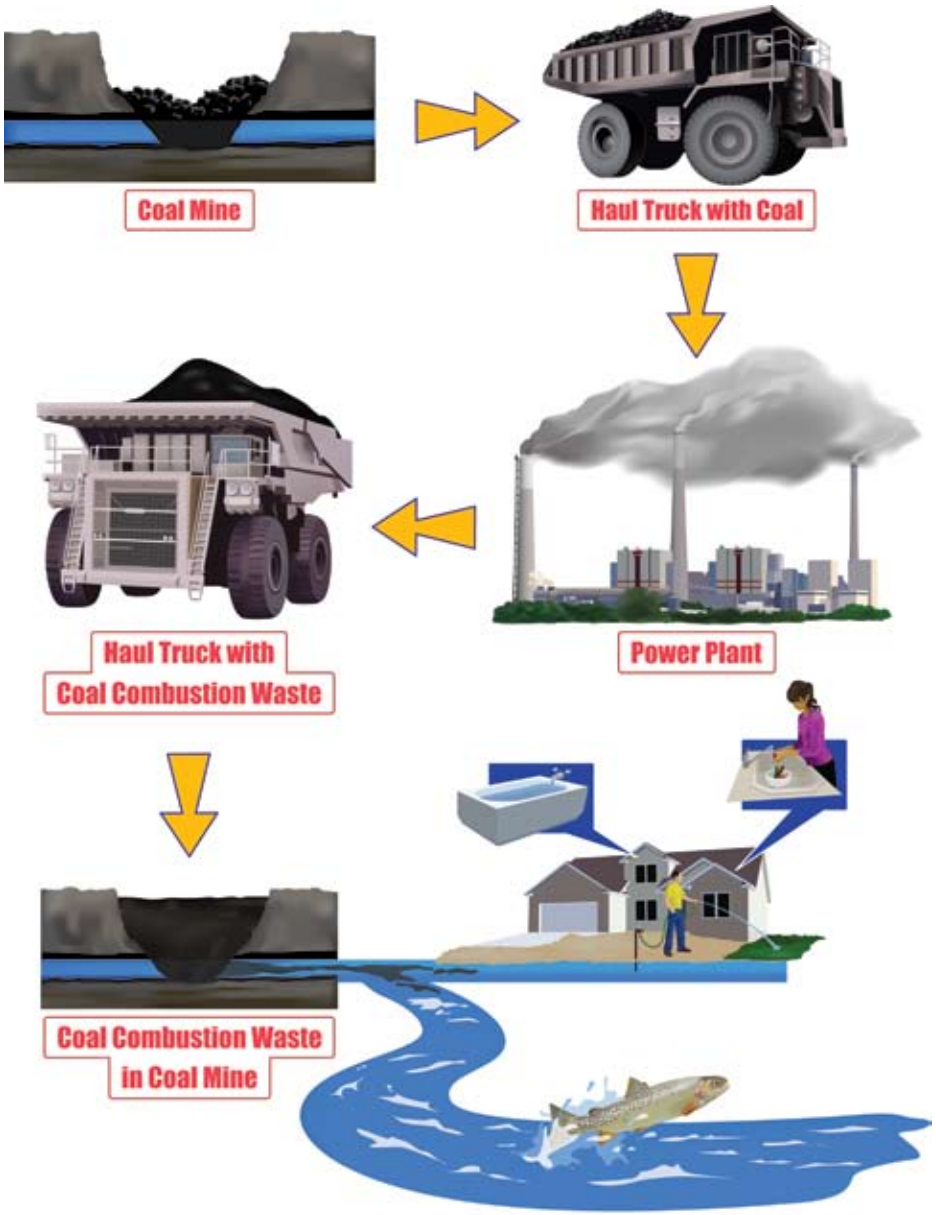
Is the Office of Surface Mining adequately regulating coal combustion waste? No

Although EPA has jurisdiction over all waste disposal under RCRA, EPA decided to cede regulation of coal combustion waste disposal in active mines to the Office of Surface Mining. In 2006, a panel of scientists appointed by the National Academies of Sciences (NAS), directed EPA to exercise its expertise and collaborate with the Department of Interior's Office of Surface Mining (OSM) to develop national minefill regulations.[49] Despite this directive, EPA refused to become actively involved and deferred entirely to OSM, an agency without institutional experience in waste management. In March 2007, OSM announced in an Advance Notice of Proposed Rulemaking that it merely intends to rely on the existing authority of the Surface Mining Control and Reclamation Act (SMCRA), even though SMCRA clearly does not require the necessary safeguards.[50] OSM has allowed dumping of coal ash in active mines to grow unchecked in state after state without any federal intervention, and OSM also does not intend to change the status quo, despite the explicit recommendation of the National Academies of Sciences.[51] Lastly, even if OSM were to regulate the dumping of coal ash in active coal mines, the disposal of ash in abandoned mines would still not be subject to such regulations, because SMCRA does not have jurisdiction over abandoned mines. EPA must collaborate with OSM to close the gaps in regulatory authority and provide guidance on waste disposal regulations.

Dead trees in CCW: The Little Blue Run Residual Waste Impoundment, which straddles the border between Beaver County, PA and Hancock County, WV holds millions of tons of CCW generated by the Bruce Mansfield coal-fired power plant in Shippingport, PA. Photo credit: Mika Johnson, 2007.

It is alleged that exposure to the thallium and arsenic contained in fly ash caused this young Pennsylvania girl to experience severe hair loss as well as other exposure-related consequences, including respiratory problems. It is unknown if her hair will ever grow normally.

Figure 8. Coal Lifecycle Chart. Environmental Consequences of "Returning" Coal Combustion Waste to the Coal Mine. (Graphics courtesy of Matt Lau)



Are state and local governments adequately regulating coal combustion waste disposal in mines? No.

As detailed above, many state regulatory agencies actually encourage industry practices that increase human exposure to coal combustion waste.

For example, Pennsylvania and West Virginia promote the burning of waste coal and allow mine dumping to be classified as a "beneficial" use with few restrictions. No state, with the exception of Kentucky, provides the safeguards recommended by the National Academies of Sciences for coal combustion waste minefilling. All other states fail to protect coalfield communities by neglecting to follow the most basic tenets of safe waste management, including requiring strict separation of waste from water, long term groundwater monitoring, and bonds to ensure sufficient funds to clean up contamination if it occurs. While all coal-producing states prohibit the unregulated disposal of soda cans and banana peels (i.e., household trash) in mines, none, save Kentucky, impose similar safeguards when toxic ash is dumped in a mine.

Figure 5 on page 5 illustrates EPA's mandatory federal safeguards for sanitary landfills, including the role of liners, monitoring wells, clay caps, and leachate collection systems and compares these safeguards with the typical unregulated CCW minefill. Figure 8 illustrates the "lifecycle" of coal dumped in a mine, revealing the potential damage to health and the environment.

Conclusion: How to Minimize the Risk from Coal Combustion Waste

What should be done about coal combustion waste disposal in mines?

In 2006, at the request of Congress, the National Academies of Sciences conducted a study of the health, safety, and environmental risks associated with using coal combustion waste for reclamation in active and abandoned coal mines.

The National Academies of Sciences concluded that *disposing of CCW in mines can cause unacceptable harm if it is not carried out under minimum federal safeguards set forth in enforceable regulations*. In addition, the National Academies of Sciences recommended that before coal combustion waste is disposed in any coal mine, opportunities for safe reuse of CCW should be fully explored.

For coal ash that is placed in mines, the National Academies of Sciences stated that new regulations should address active and abandoned mines and that federal regulations must ensure that:

- Coal combustion waste is fully tested (or "characterized") to determine its hazardous characteristics and its potential to leach toxic chemicals;
- Disposal sites are fully characterized (i.e. investigated to determine the quality

The residents who live downhill, downstream, and downwind of our nation's coal mines deserve better.

and location of groundwater, groundwater flow paths, the potential for coal ash to react with minerals or groundwater, etc.);

- Coal ash contact with water must be minimized;
- Site-specific management plans are implemented at all disposal sites;
- Monitoring is designed to detect movement of coal combustion waste contaminants;
- Site-specific performance and clean up standards are established;[52]
- Deeds record and fully disclose that coal combustion waste was disposed at the mine site;
- Bonds or other mechanisms address clean up of groundwater from coal combustion waste disposal.[53]

Lastly, the National Academies of Sciences report stated that the public should be actively involved in developing these regulations, commenting on proposed permits, and enforcing them at mine sites.

Follow the recommendations of the National Academies of Sciences

Rather than collaborating on developing enforceable mine disposal standards, EPA punted its obligation entirely to OSM – an office that has already stated that it will simply declare that existing insufficient SMCRA regulations will apply to coal combustion waste disposal in mines.[54] Yet, these existing regulations were not designed to apply to the management of industrial wastes like CCW.[55] *EPA, for its part, has voiced no objection or concern to this approach by OSM.*

Get EPA involved in protecting the environment

This lack of action on the part of federal regulators is egregious. Uncontrolled dumping of coal combustion waste into groundwater in coal mines violates the basic prohibitions in federal waste law (RCRA) against open dumping. The failure, for decades, of EPA to regulate CCW has resulted in weak state standards, at best, or, at worst, the complete absence of regulations for a waste that poses significant threats to human health and the environment. Some 23 states have a provision in their law that prohibits the state from having stricter waste standards than federal law, meaning that *without federal regulation, there will be no regulation of CCW beyond what few safeguards there are now.*[56]

The proper management of coal combustion waste is essential for protection of human health and the environment. Not only is CCW corrosive, it contains high concentrations of numerous metals, toxic trace elements, and salts. Coal combustion waste disposal has contaminated water supplies and damaged life and the environment at more than 70 sites across the nation. Most CCW disposal sites are not even monitored, and EPA readily admits that damage and threats to human health from this waste are likely to be far more widespread than currently documented.[57] EPA's data further reveal that CCW is becoming more toxic as mercury and other pollution controls are enforced at power plants. Federal regulations are needed to ensure that common sense safeguards such as placement above water tables, adequate monitoring, and clean up standards are employed in every state. These safeguards will remove the economic incentive to dump these wastes in mines.

EPA is the federal regulatory agency charged with protecting human health and the environment from the mismanagement of industrial wastes. The evidence of harm caused by minefilling is more than sufficient to justify the immediate establishment by EPA of minimum national standards that follow the recommendations of the National Academies of Sciences.

The true cost of minefilling lies in the heavy toll it takes on the health and environment of our coalfield communities. OSM suggests that even if the disposal of coal combustion waste at mine sites serves no beneficial purpose, the disposal in mines is still appropriate because the lands are already disturbed. Yet the residents who live downhill, downstream, and downwind of our nation's coal mines deserve better. Many of these communities are populated by low-income residents whose health is already compromised by the effects of coal mining.[58] These communities should not now be dumping grounds for toxic coal combustion waste. Justice, fairness and common sense dictate that citizens living within a coalfield deserve the same protections as people living elsewhere. ■

Notes

1 U.S. Department of Energy (2004). Coal Combustion Waste Management at Landfill and Surface Impoundments 1994-2004. DOE/PI-004, ANL-EVS/06-4 at page 3.

2 U.S. EPA (1999). Report to Congress, Wastes from the combustion of fossil fuels. Volume 2 – Methods, findings, and recommendations. Office of Solid Waste and Emergency Response, Washington, DC. EPA 530-R-99-010. March, 1999.

3 Block, C., Dams, R. (1976). "Study of fly ash emissions during combustion of coal." Envir.Sci.and Tech. 10: 1011.

4 Electric Power Research Institute (EPRI) (1983). "Pilot Study of Time Variability of Elemental Concentrations in Power Plant Ash." Stanford University, Stanford, California and Radian Corporation, Austin, Texas.

5 U.S. EPA (2006). Characterization of Mercury-Enriched Coal Combustion Residues from Electric Utilities Using Enhanced Sorbents for Mercury Control. EPA/600/R-06/008. (January).

6 Ibid.

7 U.S. EPA, Office of Research and Development. "Evaluating the Fate of Metals from Management of Coal Combustion Residues from Implementation of Multi-pollutant Controls at Coal-fired Electric Utilities," Presentation for 32nd Annual EPA-A&WMA Information Exchange. December 4, 2007.

8 U.S. EPA (2007) Human and Ecological Risk Assessment of Coal Combustion Wastes, August, 6, 2007 (draft).

9 Ibid.

10 Adriano, D.C., Page, A.L., Elseewi, A.A., Chang, A.C., Straughan, I.R. (1980). Utilization and disposal of fly ash and other coal residues in terrestrial ecosystems. Journal of Environmental Quality, 9: 333.

11 Carlson, C.L., Adriano, D.C. (1993). Environmental impacts of coal combustion residues. Journal of Environmental Quality, 22: 227-247.

12 U.S. Environmental Protection Agency, "Damage Case Assessment under RCRA for Fossil Fuel Combustion Wastes," dated August 2006. This assessment recognizes 24 proven damage cases and 39 "potential" damage cases. Damage cases are CCW disposal sites that show evidence of groundwater and/or surface contamination.

13 Ibid.

14 Ibid.

15 Taugher, Mike. "Water Worries & Shumway Arroyo Was At Center of 1980s Lawsuits", Albuquerque Journal, A1 & A10, October 24, 1999.

16 Skorupa, Joseph, P. (1998). Selenium poisoning of fish and wildlife in nature: Lessons from twelve real-world examples, from Environmental Chemistry of Selenium. Marcel Dekker, Inc. New York.

17 Cherry, D.S. (1999). A review of the adverse environmental impacts of coal combustion wastes. Prepared for the Hoosier Environmental Council, November 10, 1999.

18 Hopkins, W.A., C.L. Rowe, J.H. Roe, D.E.Scott, M.T. Mendonta and J.D. Congdon, (1999). Ecotoxicological impact of coal combustion byproducts on amphibians and reptiles. Savannah River Ecology Laboratory, presented at the Society for Environmental Toxicology and Chemistry, 20th Annual meeting, Philadelphia, PA, November 14-18. Abstract # PMP009.

19 Aranyi, C. et al. (1979). Cytotoxicity to alveolar macrophages of trace metals adsorbed on fly ash. Envr. Res. 20, 14-23.

20 Chauhan et al. (1989). Induction of pulmonary and hepatic cytochrome p-450 species by coal fly ash inhalation in rats. Toxicology, 56, 95-105.

21 Smith et al. (1999). Interleukin-8 levels in human lung epithelial cells are increased in response to coal fly ash and vary with the bioavailability of iron, as a function of particle size and source of coal. American Chemical Society, October 1999.

22 Srivastava et al. (1984). Distribution of metals of inhaled fly ash in various organs of rats at various periods after exposure. Environmental Science Health, A19(6), 663-677.

23 U.S. EPA (2002). Mine Placement of Coal Combustion Waste, State Program Elements, Final Draft, December 2002.

24 American Coal Ash Association (2007). Coal Production Products Production and Use Survey, 2006. http://www.acaa-usa.org/associations/8003/files/2006_CCP_Survey_(Final-8-24-07).pdf.

25 Ibid.

26 Clean Air Task Force, Impacts of Water Quality from Placement of Coal Combustion Waste in Pennsylvania Coal Mines, September 2007. www.catf.us

27 Board of Supervisors of Robinson Township, Washington County, Pennsylvania. In re: Conditional Use Application And Major Land Development Application Of Champion Processing, Inc. ("Champion Processing" And Robinson Power Company, LLC ("Robinson Power") Decision, Findings Of Fact And Conclusions Of Law, September 11, 2006.

28 Ibid.

29 Ibid.

30 Public Service New Mexico's San Juan Generating Station and Arizona Public Service's Four Corners Power Plant, both located near Farmington, NM, dispose of approximately a million tons of coal combustion waste annually in the San Juan Mine and Navajo Mine, respectively. Both mines are active coal mines located near the power plants. This estimate is based on testimony of Public Service New Mexico, Arizona Public Service, and BHP Minerals at hearings of the National Research Council's Committee on Mine Placement of Coal Combustion Wastes, December 6 and 7, 2004. Farmington, New Mexico.

31 Clean Air Task Force, Impacts of Water Quality from Placement of Coal Combustion Waste in Pennsylvania Coal Mines, September 2007. Executive Summary. www.catf.us.

32 Pennsylvania General Assembly, 2004, Joint Legislative Air and Water Pollution and Conservation Committee, Report on Proposed Moratorium on the use of Fly Ash in Mine Reclamation Projects.

33 Testimony before the Joint Legislative Air and Water Pollution Conservation Committee of the Pennsylvania General Assembly in 2004, Billie Ramsey, the Executive Director and General Counsel for ARIPPA. ARIPPA is a trade association comprising fourteen power producers in Pennsylvania that generate electricity by using FBC technology to burn coal mining refuse.

34 Ibid.

35 Clean Air Task Force, Impacts of Water Quality from Placement of Coal Combustion Waste in Pennsylvania Coal Mines, September 2007, page 683. www.catf.us

36 Pennsylvania Department of Environmental Protection, Coal Ash Beneficial Use in Mine Reclamation and Mine Drainage Remediation in Pennsylvania, December 2004. Chapter 1.

37 U.S. Department of Energy, 2002. Energy Information Administration.

38 These values were predicted using the actual tonnage of coal burned by an FBC boiler and a PC boiler in Pennsylvania during 2006. http://www.eia.doe.gov/cneaf/electricity/page/eia906_920.html.

39 Sierra Club, 2008. www.sierraclub.org/environmentallaw/coal/plantlist.asp.

40 Waste coal contains, on average 0.4 ppm of mercury compared to 0.1 ppm of mercury, on average, in bituminous coal. Electric Power Research Institute. *An Assessment of Mercury Emissions from U.S. Coal-fired Power Plants*. EPRI, Palo Alto, CA: 2000. 1000608.

41 Federal Register, Volume 65, number 99, page 32,213. Regulatory determination on wastes from the combustion of fossil fuels. Final rule. May 22, 2000.

42 Pennsylvania Department of Environmental Protection, Coal Ash Beneficial Use in Mine Reclamation and Mine Drainage Remediation in Pennsylvania, December 2004. Chapter 9, Figure 9.37, page 284.

43 Stewart, B.R., 1996. The influence of fly ash additions on acid mine drainage production from coarse coal refuse. PhD. Dissertation. Virginia Polytechnic Institute and State University, Blacksburg, VA. pages 195-198.

44 Skousen, Jeff & Bhumbla, D.K. , Metal Release From Fly Ash Upon Leaching with Sulfuric Acid or Acid Mine Drainage, National Meeting of the American Society for Surface Mining and Reclamation, St. Louis, MO, May 16-21, 1998.

45 McDonald, Louis M. and Simmons, Jennifer. Effects of Large-Scale CCB Applications on Groundwater: Case Studies, Final Report, April 15, 2004, CBRCE-37, page 6. The complete report can be viewed at the Combustion Byproducts Recycling Consortium Web site at http://wwwri.nrcce.wvu.edu/cbrc.

46 Clean Air Task Force, Impacts of Water Quality from Placement of Coal Combustion Waste in Pennsylvania Coal Mines, September 2007. Chapter 3. www.catf.us.

47 Ibid.

48 Ibid at 33,214.

49 National Academies Press. Managing Coal Combustion Residues in Mines. Committee on Mine Placement of Coal Combustion Wastes, National Research Council. Available at http://www.nap.edu/catalog/11592.html.

50 Office of Surface Mining Reclamation and Enforcement, "Advanced Notice of Proposed Rulemaking on Placement of Coal Combustion Byproducts in Active and Abandoned Coal Mines," 72 Fed Reg, 12026, March 14, 2007.

51 Office of Surface Mining, Western Region. Guidance on Disposal of Coal Combustion Byproducts in the Western United States when OSM Western Region is the Regulatory Authority. Approved February 6, 2001. http://www.wrcc.osmre.gov/CCBguidance.html.

52 National Academies Press. Managing Coal Combustion Residues in Mines. Committee on Mine Placement of Coal Combustion Wastes, National Research Council. Available at http://www.nap.edu/catalog/11592.html.

53 Ibid.

54 Office of Surface Mining Reclamation and Enforcement, "Advanced Notice of Proposed Rulemaking on Placement of Coal Combustion Byproducts in Active and Abandoned Coal Mines," 72 Fed Reg, 12026, March 14, 2007.

55 OSM recognized the limitations of its responsibility and authority in a white paper entitled Placement of CCBs at Coal Mines – Risk Assessment (January 17, 2006), in which it also acknowledged that the determination of risk to public health and the environment during a permit review would require a complete physical and chemical analysis of the CCB materials to predict leaching potentially toxic pollutants; a detailed plan for placement of the materials; and a monitoring plan sufficient to ensure that post-reclamation groundwater quality is not contaminated.

56 U.S. EPA (2002). Mine Placement of Coal Combustion Waste, State Program Elements, Final Draft, December 2002.

57 U.S. EPA (2007) Human and Ecological Risk Assessment of Coal Combustion Wastes, August, 6, 2007 (draft).

58 Hendryx, M. and M.M.Ahern (2008). Relations between health indicators and residential proximity to coal mining in West Virginia. Amer. J. Pub. Health, Vol. 98, No. 4, 669-671.

Haze over the Four Corners Power Plant, Navajo Nation Reservation, Fruitland, NM Photo credit: Bruce Gordon, EcoFlight.

EARTHJUSTICE

Because the earth needs a good lawyer

www.earthjustice.org/coalash