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The electric power industry is the largest toxic polluter in the country, and coal, which is used to generate over half of the electricity produced in the U.S., is the dirtiest of all fuels.[1] From mining to coal cleaning, from transportation to electricity generation to disposal, coal releases numerous toxic pollutants into our air, our waters and onto our lands.[2] Nationally, the cumulative impact of all of these effects is magnified by the enormous quantities of coal burned each year – nearly 900 million tons. Promoting more coal use without also providing additional environmental safeguards will only increase this toxic abuse of our health and ecosystems.

The trace elements contained in coal (and others formed during combustion) are a large group of diverse pollutants with a number of health and environmental

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Property and scenic values are degraded as agricultural crops, forests, rangeland and deserts are replaced by pits, quarries and tailing piles. Restoring or reclaiming a surface mine by replacing vegetation and restoring the landscape to its original contours helps minimize any permanent disruption. However, hundreds of thousands of acres of surface mines have not been reclaimed, and reclamation of steep terrain, such as found in Appalachia, is difficult.[5] Finally, despite reclamation efforts, ecosystems may be destroyed and replaced by a totally different habitat.

Coal mining irreparably damages the environment.

Mining impacts both surface waters and groundwater. In underground mining, waste materials are piled at the surface creating runoff that both pollutes and alters the flow of local streams. As rain percolates through these piles, soluble components are dissolved in the runoff and cause the elevation of total dissolved solids (TDS) in local water bodies. The presence of TDS in a stream usually indicates that sulfates, calcium, carbonates and bicarbonates are present. While not a direct threat to human health, these pollutants make water undrinkable by altering its taste and can also degrade water to the point where it can't be used for industry or agriculture.[6]

Acid mine drainage is a particularly severe byproduct of mining especially where coal seams have abundant quantities of pyrite. When pyrite is exposed to water and air, it forms sulfuric acid and iron. The acidity of the runoff is problematic by itself, but it also dissolves metals like manganese, zinc and nickel, which then become part of the runoff.[7] The resulting acidity and presence of metals in the runoff are directly toxic to aquatic life and render the water unfit for use.[8] Some metals bioaccumulate in the aquatic food chain. Additionally, bottom-dwelling organisms can be smothered by iron that settles out of the water.

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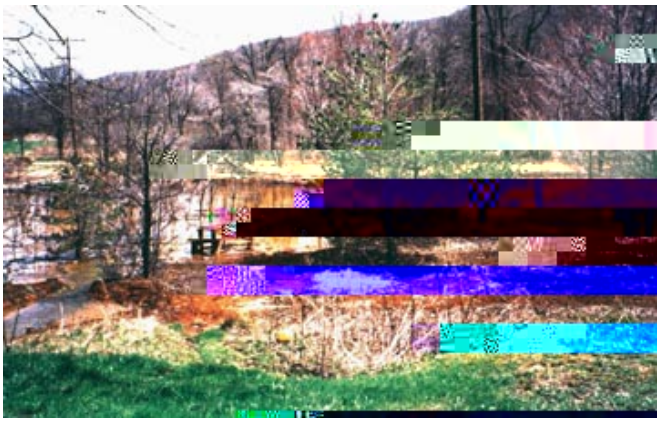
Also of concern is the impact mining has on groundwater, including contamination and physical dislocation of aquifers. These are typically localized effects. Acid mine drainage that seeps into groundwater is a common cause of contamination.[9] Physical disruption of aquifers can occur from blasting which can cause the groundwater to seep to a lower level or even connect two aquifers (leading to contamination of both). When a mine is located below the water table, water seeps into the mine and has to be pumped out. This can lower the water table and even dry up nearby wells. The process of mining, followed by reclamation, changes the permeability of overlying soil, alters the rate of groundwater discharge and increases flooding potential.[10]

Underground mines not only impact groundwater hydrology, they are prone to subsidence.[11] Subsidence occurs when the ground above the mine sinks because the roof of the mine either shifts or collapses. Subsidence can alter ground slopes to such an extent that roads, water and gas lines and buildings are damaged. Natural drainage patterns, river flows and aquifers can also be altered. The extent and severity of the subsidence depends on numerous factors including how thick the overlying soil and rock layers are and the mining method. These problems can be addressed by preventive methods such as leaving enough coal in place to provide structural support to the mine roof. Deliberately collapsing the mine after the coal is extracted causes subsidence to occur sooner, but more evenly. For existing mines, one "corrective" measure that has been used is backfilling the mine with either mine wastes or combustion wastes. While this approach may seem to solve both subsidence and waste disposal problems, it is actually expensive and dangerous and releases contaminants to the groundwater.[12] In addition, these wastes often lack the structural strength to support the mine roof.

Mine wastes are generated in huge quantities – on the order of tens of millions of tons per year.[13] These wastes include the solid waste from the mine, called "gob," refuse from coal washing and coal preparation, and the sludge from treating acid mine drainage. There are a number of environmental impacts from this waste generation. First, the land where these wastes are dumped is no longer useable for other purposes. Second, the piles are flammable and susceptible to spontaneous combustion. Third, they are prone to erosion which is a major concern because the runoff and seepage from these piles is highly acidic. As noted above, this acidic runoff contains heavy metals which can end up in local



Acid mine drainage pollutes rivers and wetlands, Indian Creek Watershed, PA. (Photo: Debra Adams, Mountain Watershed Assoc.)

tons – all of these pollutants are released in significant quantities.

Under the CAA, National Ambient Air Quality Standards (NAAQS) have been set for six so-called "criteria" pollutants: nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter (PM), lead, carbon monoxide and ozone. In 1990, the CAA was amended to require additional cuts in SO_2 emissions. However, despite steps underway to reduce emissions, a loophole in the CAA exempts many of the nation's old coal-fired power plants from modern pollution standards for NO_x and SO_2. These "grandfathered" plants emit up to 10 times more pollution than modern coal plants. As a result, millions of tons of these pollutants are released to the atmosphere each year.[20]

In addition to the loophole for grandfathered power plants, until recently a different provision in the CAA exempted all power plants from any emission limits for hazardous air pollutants (like mercury, other metals and acid gases). The EPA decided in December 2000 to develop standards by 2004 for hazardous air pollutants. However, as discussed below, after being collected by pollution control devices to prevent emissions to the air, these pollutants are merely shifted to another waste stream as either liquid or solid wastes. In the absence of air standards and standards addressing other waste streams, an increased reliance on coal will mean increased releases of toxic chemicals to the environment.

Coal-fired power plants are among our largest sources of CO_2 emissions, which have been linked to climate change. Atmospheric CO_2 admits incoming sunlight, but traps the heat radiating from Earth's surface (the way heat is trapped in a greenhouse, hence the "greenhouse effect").[22] The greenhouse effect is predicted to result in higher temperatures that may affect the global distribution of rainfall and subsequent land use (including agriculture) as well as ecological effects on forests, lowering of lake levels and waterways from increased evaporation rates and rising ocean levels due to melting ice caps.[23] An increased reliance on conventional coal

Pollutant	**1990 Emissions** (tons)

technology in electricity production will ensure that CO_2 emissions continue to increase.[24]

Continual loading of pollution to the environment is of special concern for contaminants that are either metals and/or persist in the environment because of their chemical structure (e.g., mercury and dioxin). These pollutants either never go away or do not degrade for an extremely long time. Over a long period of time, a large fraction of these contaminants may become buried in sediments; however, even small residual amounts of these contaminants are a concern. For instance, a persistent bioaccumulative toxin like mercury accumulates and concentrates in the food chain, which leads to human and wildlife exposure to methylmercury.

Table 1 shows emission estimates for the major criteria and hazardous pollutants emitted from coal-fired power plants.

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Substance	Human Toxicity		Comments
	Acute	Chronic	
Sulfur dioxide	Lung irritant, triggers asthma, low birth weight in infants.	Reduces lung function, associated with premature death.	Also contributes to acid rain and poor visibility.
Nitrogen oxides	Changes lung function, increases respiratory illness in children.	Increases susceptibility to respiratory illnesses and causes permanent alteration of lung.	Forms ozone smog and acid rain. Ozone is associated with asthma, reduced lung function, adverse birth outcomes and allergen sensitization.
Particulate Matter	Asthma attacks, heart rate variability, heart attacks.	Cardiovascular disease, pneumonia, chronic obstructive pulmonary disease, premature death.	Fine particle pollution from power plants is estimated to cut short the lives of 30,000 Americans each year.
Hydrogen chloride	Inhalation causes coughing, hoarseness, chest pain, and inflammation of respiratory tract.	Chronic occupational exposure is associated with gastritis, chronic bronchitis, dermatritis, photo sensitization in workers.	
Hydrogen Fluoride	Inhalation causes severe respiratory damage, severe irritation and pulmonary edema.		Very high exposures through drinking water or air can cause skeletal fluorosis.
Arsenic	Ingestion and inhalation: affects the gastrointestinal system and central nervous system.	Known human carcinogen with high potency. Inhalation causes lung cancer; ingestion causes lung, skin, bladder and liver cancer. The kidney is affected following chronic inhalation and oral exposure.	
Cadmium	Inhalation exposure causes bronchial and pulmonary irritation. A single acute exposure to high levels of cadmium can result in long-lasting impairment of lung function.	Probable human carcinogen of medium potency. The kidney is the major target organ in humans following chronic inhalation and oral exposure.	Other effects noted from chronic inhalation exposure are bronchiolitis and emphysema.
Chromium	High exposure to chromium VI may result in renal toxicity, gastrointestinal hemorrhage and internal hemorrhage.	Known human carcinogen of high potency.	Chronic effects from industrial exposures are inflammation of the respiratory tract, effects on the kidneys, liver, and gastrointestinal tract.
Mercury	Inhalation exposure to elemental mercury results in central nervous system effects and effects on gastrointestinal tract and respiratory system.	Methyl mercury ingestion causes developmental effects. Infants born to women who ingested methylmercury may perform poorly on neurobehavorial tests.	The major effect from chronic exposure to inorganic mercury is kidney damage.

a Agency for Toxic Substances and Disease Registry Online. ToxFAQs. Division of Toxicology, Atlanta, Georgia.

b U.S. EPA, 2000. Integrated risk information system (IRIS). Online. Office of Health and Environmental Assessment, Cincinnati, Ohio.

Exposure to air pollutants from power plants may occur from direct inhalation or indirect exposure i.e., subsequent ingestion of water, soil, vegetation, or meat, eggs, dairy products, and fish that became contaminated through accumulation in the food chain.[25] Absorption through the skin (dermal absorption) of power plant pollutants may also occur from direct contact with contaminated soil and water. Children generally younger than age 6 may also be exposed to pollutants by ingesting contaminated soil. Pollutants for which indirect exposure is especially important include mercury, arsenic, dioxins, cadmium and lead. Mercury contamination of fish (and subsequent consumption by humans) is the cause of fish consumption advisories in 40 states for inland waters and advisories for some saltwater species in 10 states.[26] In spite of regulations for criteria pollutants, 141 million Americans live in counties where the federal ozone standard was exceeded in 1999.[27]

Direct inhalation of the various components of power plant air pollution can cause asthma attacks, respiratory infections, or changes in lung function. For example, when inhaled, SO_2 irritates the lungs, triggering bronchial reactions and reducing lung function. The most measurable effects occur in children and in people with an already-compromised lung function.[28] Other pollutants are absorbed and distributed in the body and may produce systemic effects or effects distant from the entry point of the lungs. As a result, organs other than the lungs (e.g. the central nervous system, brain, heart, blood, liver and kidneys) can be affected by air pollutants. Systemic toxicants may cause both cancer and non-cancer effects. Table 2 presents specific health effects information for representative power plant pollutants.

Subpopulations that may be more sensitive to air pollution include infants and children, elderly people, pregnant women and nursing mothers, and people with chronic diseases, such as asthma. Children are not only more sensitive because they are at critical stages of physical and mental development, but they receive a relatively higher pollutant dose compared to adults because they have a lower body weight and higher breathing rate. People who tend to eat locally grown produce and locally caught fish may also receive higher than average exposure to deposited pollutants if they live close to a facility. In addition, some pollutants are transported in the atmosphere and deposit far from the source. For instance, sulfur dioxide is transformed in the atmosphere to sulfuric acid and sulfates, which deposit up to 1000 miles from the source.

percolate to the groundwater, the disposal units are actually designed to allow this.

An industry survey of disposal units revealed that about 40 percent of the coal waste landfills and 80 percent of the coal waste surface impoundments do not have liners, and less than half the landfills and only one percent of impoundments have leachate collection systems.[43] In addition, there are also direct discharges to surface waters either by permitted discharges or overflow drainage from impoundments. These discharges are regulated by the CWA. Under the CWA, limitations have been established for discharges of Total Suspended Particulate (TSP), oil and grease, pH, copper, iron, free chlorine and temperature. Rarely, however, do state regulations limit the discharge of other, more toxic, contaminants known to be in coal and oil combustion waste.

Power plant CCW contains concentrated levels of numerous contaminants, particularly metals like arsenic, mercury, lead, chromium and cadmium, and radioactive elements found naturally in coal.[44] If these contaminants enter the environment, either through dust, leaching into groundwater or from discharges into surface waters, they can contaminate drinking water supplies and accumulate in livestock and crops. As a result, people living in the vicinity of the power plant can be exposed to the pollutants in these wastes by ingesting groundwater into which the contaminants (especially metals) have leached, eating the exposed livestock or crops, inhaling contaminants contained in windblown dust or from coming into contact with, or ingesting soils onto which these wastes have been applied.[45,46] For children who come into contact with dirt during play, soil ingestion is a particularly important route of exposure. People and wildlife are also exposed to selenium and mercury by eating contaminated fish from local waters affected by power plant wastes and air emissions. There are numerous examples of mercury fish consumption advisories in lakes and rivers in proximity to power plants. In Texas and North Carolina, selenium fish consumption advisories in certain reservoirs have been directly linked to power plant combustion waste disposal.[47]

In addition to posing threats to public health, power plant CCW disposal has been documented as causing severe and potentially irreversible ecological damage.[48] The pollutants enter nearby surface water in water discharges from surface impoundments or overflow drainage systems and runoff from coal piles. Research has documented serious impacts on species of amphibians, waterfowl and fish. Some of the contaminants found in power plant wastes accumulate in animal tissues to levels hundreds of times higher than levels found in the environment.

EPA assessed the human health impacts from toxic metals (many of which are known or suspected to cause cancer in humans) in CCW that leach from unlined landfills and surface impoundments and contaminate

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5 Ibid.

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17 This brief list is by no means all-inconclusive with regard to worker exposure or safety hazards. For additional information, please refer to the Mine Safety and Health Administration's (MSHA) at: www.msha.gov

18 Op. cit. Office of Technology Assessment, 1979.

19 Advanced coal power plants that gasify (rather than combust) coal are beginning to enter the power market. These plants show potential to have dramatically lower air pollution emissions than even fully controlled conventional power plants that combust coal. These plants also produce substantially lower volumes of solid waste than do new, conventional coal plants.

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24 Advanced coal gasification plants that are beginning to enter the market could potentially be developed or retrofitted with commercially available technology to sequester CO_2 produced by these plants. Thus these plants potentially are more compatible with addressing climate change than conventional plants that combust coal.

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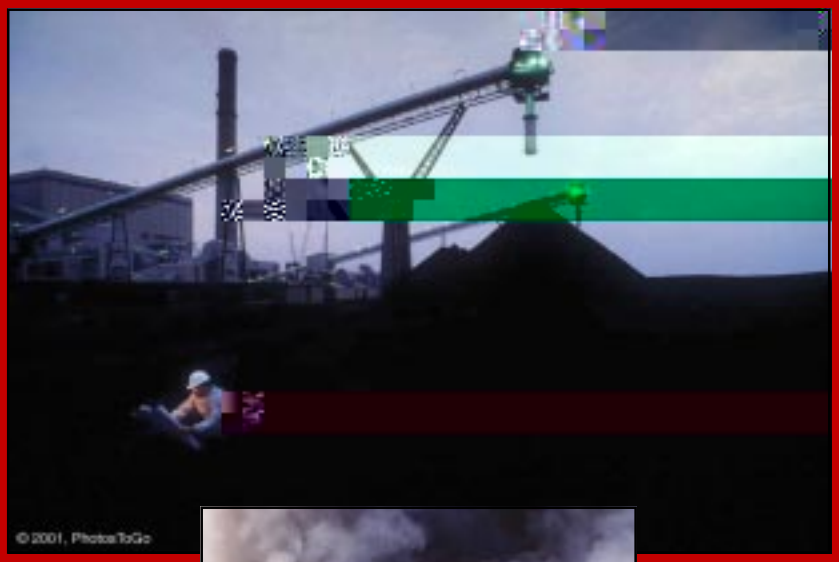

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