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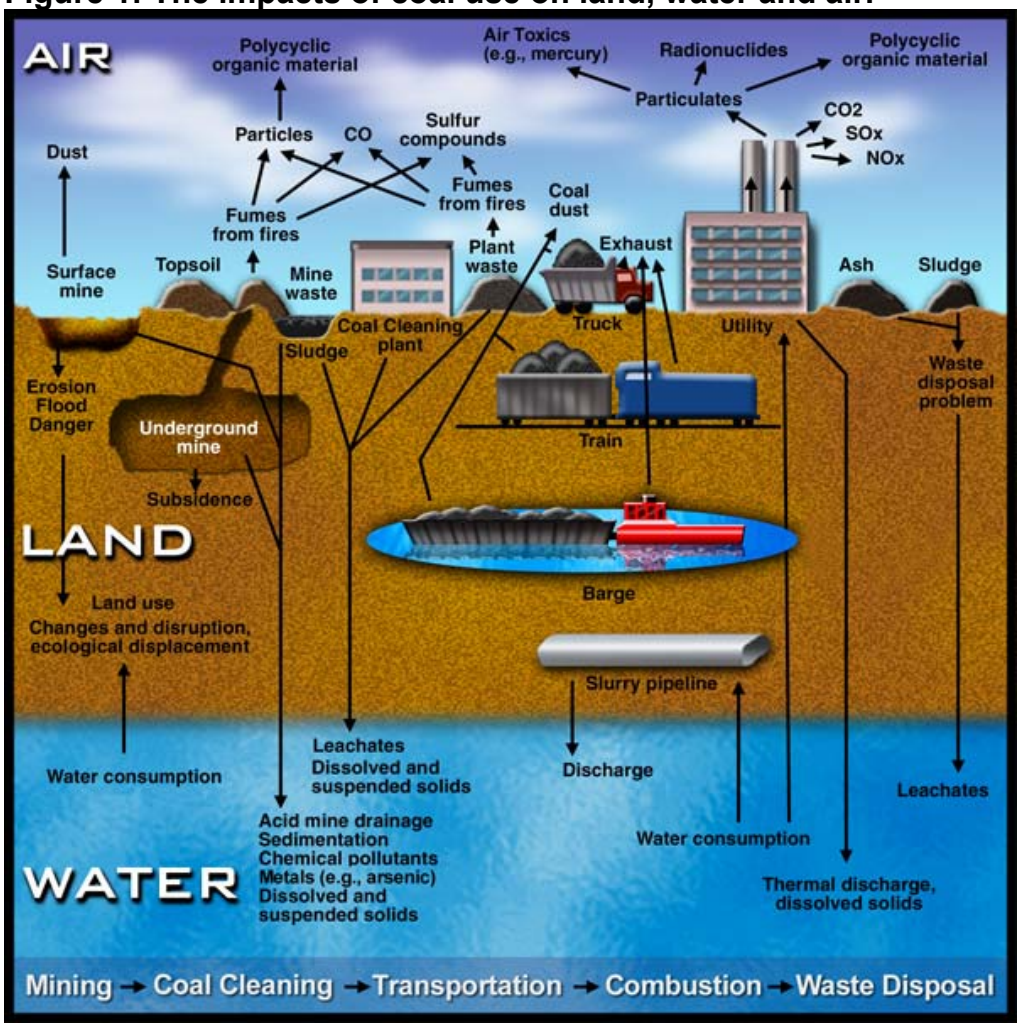
The Environmental Impacts of Coal

A toxic industry

Coal is the dirtiest of all fuels. From mining to coal cleaning, from transportation to electricity generation to disposal, coal releases numerous toxic pollutants into the air, water and land. These disrupt ecosystems and endanger human health. Some cause cancer, others damage the nervous and immune systems, and some impede reproduction and development. [i]

The environmental effects of coal use range from the poisoning of local rivers by acid mine drainage to the global problem of climate change caused by CO_2 (carbon dioxide) emissions. 'Clean coal' technologies are expensive and are still unable to completely remove harmful emissions from coal-fired power plants.[ii] Figure 1 illustrates the various impacts of coal-use on land water and air.

Figure 1: The impacts of coal use on land, water and air.



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Coal mining

Coal mining causes extensive degradation to natural ecosystems such as forests and can scar the landscape irreparably. Damage to humans, animals and plants, occurs due to habitat destruction and environmental contamination.

Mine wastes

Mine wastes are generated in huge quantities and must be disposed of. The wastes are flammable and prone to spontaneous combustion.[iii] They also contain heavy metals capable of leaching out into local rivers, streams and groundwater. Coal washing generates similar waste problems[iv]

Acid mine drainage (AMD)

Sulphuric acid is created when exposed coal gets wet and dissolves toxic metals.[v] The resulting run-off is directly toxic to aquatic life and renders the water unfit for use. Furthermore, some of the metals bioaccumulate (i.e. build up in living things) along the aquatic food chain.[vi] Up to 125km of waterways on the West Coast of the South Island are already contaminated from AMD from historic and current coal mines.[vii] Solid Energy's Stockton mine alone produces some 30,000 million litres of AMD annually. AMD can contaminate drinking water sources and plague nearby communities for centuries, or even longer.[viii]

Health and safety in the mines

Mining is dangerous and has high injury and mortality rates. Potential health and safety hazards include respiratory illnesses such as emphysema, black lung disease and chronic bronchitis; exposure to toxic fumes and gases; noise-induced hearing loss; heatstroke and exhaustion.[ix]

Transportation

Trucks, rail and barges used to transport coal all affect air and water quality. As well as the environmental and health impacts from blowing coal dust, there is also the air pollution from the vehicles themselves.[x]

Coal-fired power generation

Coal-fired power plants emit more than 60 different hazardous air pollutants. Yet, despite billions of dollars of investment, scientists are unable to completely remove harmful emissions from plants. [xi] Pollution from coal-fired power stations is released in four main ways; (i) as fly ash from the smoke stack, (ii) bottom ash which stays at the bottom after the coal is burned, (iii) waste gases from the scrubber units (which are chemical processes used to remove some pollutants) and (iv) gas released into the air. Table 1 shows the health effects of the main coal-fired power plant pollutants.

SO_2 (sulphur dioxide) and NO_X (nitrogen oxides)

Coal-fired power plants produce large quantities of SO_2 and NO_X, the key pollutants in the formation of acid rain. Acid rain acidifies water bodies, and harms forest and coastal ecosystems. SO_2 and NO_X contribute to the formation of particulates (see below). NO_X helps form of ozone (smog) and nitrates.[xii] Ozone impairs lung function and reduces the yields of many economically important agricultural crops. Nitrate deposition over-enriches water bodies, causing algal blooms that kill fish and reduce biodiversity.[xiii]

Particulates (fine particles)

Coal-fired power plants are a major source of particulate pollution. Many scientific studies have shown that raised levels of particulates result in increased illness and premature death from heart and lung disorders, such as asthma and bronchitis.[xiv] A recent study found that particulate pollution from US power plants cuts short the lives of almost 24,000 people a year. The largest share of particulate emissions comes not from direct emissions, but from the conversion of SO_2 and NO_X into fine particle sulphate and nitrate in the atmosphere.[xv]

Trace Elements

Coal contains numerous persistent, bioaccumulative trace elements that are released during combustion and end up in the atmosphere and water bodies. These include mercury, dioxins, arsenic, radionucleotides, cadmium and lead.[xvi]

Table 1: Health effects of selected coal-fired power plant pollutants[xvii]

Substance	Human Toxicity		Comments
	Acute (short-term) effects	Chronic (long-term) effects	
Sulphur 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 sensitisation.
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, dermatitis and photosensitisation in workers.	
Hydrogen fluoride	Inhalation causes severe respiratory damage, severe irritation and pulmonary edema (build up of fluid in the lungs)	Liver and kidney damage.	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 of high potency. Inhalation causes lung cancer; ingestion causes lung, skin, bladder and liver cancer.	
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 and internal haemorrhage.	Known human carcinogen of high potency.	Chronic effects from exposure 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 methyl mercury may perform poorly in neurobehavioral tests.	The major effect from long-term exposure to inorganic mercury is kidney damage.
Dioxin	Inhalation and absorption through the skin results in central nervous system effects, impairment of the immune system, the developing nervous system, the endocrine system and reproductive functions.	Known human carcinogen of high potency and has been linked to diabetes. Chronic occupational exposure has been linked to lung cancer, non-hodgkins lymphoma, stomach and liver cancer, soft and connective tissue cancers.	Short term effects from exposure are skin lesions, such as chloracne and patchy darkening of the skin, and altered liver function. Can interfere with normal development of a foetus or child.

(i) Mercury

Coal-fired power and heat production are the largest single source of atmospheric mercury emissions.[xviii] According to the UNEP, mercury and its compounds pose a 'global environmental threat to humans and wildlife.'[xix] Mercury is toxic to the developing brain, and exposure in the womb can cause learning disabilities, developmental delays, and other serious health problems in children. The US EPA estimates that one in six U.S. women of childbearing age has enough mercury in her blood to put her child at risk.[xx] Eating contaminated fish is the primary way people are exposed to mercury.[xxi] Mercury released into the air by power plants gets into waterways and is converted into highly toxic methyl mercury by bacteria. The methyl mercury bioaccumulates in fish which are then consumed by humans.[xxii] No technologies are available to eliminate mercury emissions from power plants.[xxiii]

(ii) Dioxins

Known human carcinogens and some of the most toxic compounds known to science, dioxins can also be formed when coal is burned, since most coal contains chlorine.[xxiv] For details of the health impacts of other trace elements see Table 1.

Coal Combustion Waste (CCW)

CCW such as fly and bottom ash, and 'captured' pollutants (pollution that has been removed during the coal burning), is normally disposed of in landfill sites or sold for industrial use. For example, Huntly power station sells some of its waste for use in cement. Regardless of how CCW is disposed of, there is a risk of toxic metals leaching into nearby surface and ground water. People who drink, over a period of years, an average amount of water contaminated with CCW have a higher risk of cancer.[xxv]

CO_2

Coal is the most carbon intensive fossil fuel, emitting 72% more climate changing CO_2 per unit of energy than gas.[xxvi]There are no commercially available technologies to capture and store CO_2. Such technology is very expensive and will not be available for at least 20-30 years.[xxvii]

Summary

'Clean coal' is a myth. Everything to do with coal - from mining to combustion to waste disposal, and all the intervening processes, adversely affect public health and the environment. An increased reliance on coal will invariably result in the increased release of toxic chemicals into the environment.[xxviii]

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[iv] Keating, M. (2001).
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[vi] *Ibid.*; Koryak, M. (1997) Origins and Ecosystem Degradation Impacts of Acid Mine Drainage, US Army Corps of Engineers, wmw.lrp.usace.army.mil/misc/AMD_Impacts.html, viewed 17/12/04.
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viii Coal Association of New Zealand (2004) CRL Energy tackles acid mine drainage, Annual Review 2004.
[ix] This list is by no means comprehensive. For more detailed information see the US Mine Safety and Health Administration (MSHA) website: www.msha.gov/S&Htopics.htm, viewed 10/12/04.
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[xiv] US EPA (2003) Effects of Acid Rain: Human Health, www.epa.gov/airmarkets/acidrain/effects/health.html, viewed 9/12/04.
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