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COMING CLEAN

The Truth and Future of Coal in Asia Pacific

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Executive Summary

King coal is booming. In the years between 2001 and 2006, coal use around the world grew by an unprecedented 30 percent; of this increase 88 percent came from developing Asia. China has the biggest share of growth, and is responsible for 72 percent of the world increase in coal since 2001. India accounts for 9 percent of the world's growth, and the economies of South East Asia and Korea make up the balance.¹ Rapid economic development in the Asia Pacific (AP) is sealing the region's reliance upon coal.

The AP region's dependence on coal is manifesting itself in three critical areas: social distress, degradation to local environments and carbon dioxide (CO₂) emissions that accelerate global warming. Coal's impacts on the region range from the depletion of arable soil, to contaminated water supplies and severe air pollution to grave respiratory illness and displaced and disenfranchised communities—communities who are often pressured into hosting the coal industry and subsequently denied the opportunity to protect their natural resources and families.

But perhaps coal's greatest threat is its contribution to global warming, which stands to unleash potentially cataclysmic environmental impacts. Coal is the dominant source of global CO₂ emissions, and in 2004 it was responsible for 41 percent of total global emissions.² According to International Energy Agency's (IEA) World Energy Outlook Reference Scenario, economic growth in India and China will account for a staggering 70 percent of the increase in global coal consumption by 2030, primarily in the electricity and industrial sectors. In 2006, according to some sources, China surpassed the US as the world's number one CO₂ emitter, and India lags only a handful of places behind China, as the globe's fifth biggest CO₂ emitter.³ However, on a per capita basis, China and India are relatively low emitters when compared to the US, EU and Japan.

At present, the market price of coal does not incorporate the coal industry's impacts on the environment and communities, despite the very real costs exacted upon them. Taking the value of social and ecological resources into account, the China Sustainable Energy Program (CSEP) of Energy Foundation found the true cost of coal in China in 2005 to be at least 56 percent higher than its market price. But the CSEP notes that these preliminary findings were not comprehensive, and most likely an underestimate.⁴ Were coal to reflect its social and environmental costs, less polluting energy sources and technologies would be more competitive in AP markets, and this would create additional capital for research, development and deployment of such sources and technologies.

WWF's *Climate Solutions: WWF's Vision for 2050* investigates how global economic development and population increase can be managed whilst also avoiding dangerous climate change. The report



concludes that mainstreaming energy services and super-efficient products can stabilise energy demand, and that the greenhouse gas emissions from energy production can be reduced to safe levels, provided that there is a shift away from fossil fuels. If fossil fuel use is reduced, the report says that a well-managed coal sector can play a role in preventing dangerous climate change, provided that advanced carbon capture and storage (CCS) is rapidly and widely deployed. But even with CCS, CO₂ emissions are still a problem, and therefore the total worldwide coal use must be constrained to levels that will adequately mitigate climate change. WWF estimates that coal used with CCS can safely account for 20 percent of the total global energy production by 2050. WWF views CCS as one possible solution to managing the world's energy needs, to be used in conjunction with the following supplementary measures:

- Increased end-use energy efficiency;
- Halting and reversing loss and degradation of forests, particularly in the tropics;
- The rapid and parallel pursuit of the full range of renewable technologies, such as wind, hydro, solar PV and solar thermal, and bio-energy within strictly defined environmental and social constraints to ensure their sustainability;
- Developing flexible fuels, energy storage and new infrastructure;
- Displacing high-carbon coal with low-carbon gas while zero emission technologies reach sufficient scale.

In order for coal's negative impacts on local environments and communities in the AP region to be reduced, WWF recommends the following measures be taken:

- Internalisation of the social and environmental costs of coal production and use;
- Immediate deployment of low emission coal technologies to reduce local pollution;
- Strengthening of government policies, particularly the Environmental Impact Assessments (EIA), that include civil society in decision-making processes and protect local communities from coal's negative impacts.



¹ BP Statistical Review Of World Energy, June, 2007.

² International Energy Agency, World Energy Outlook, 2006

³ Netherlands Environmental Assessment Agency

⁴ Energy Foundation, "The True Social Cost of Coal: The external cost for the exploitation and utilization of coal in China: a preliminary study," 2006.

Introduction: Yesterday's Super Fuel, Today's Super Polluter



Since the advent of the first coal-fired power plant in the U.S. in the late 19th century, coal has fast become the global poster-child for energy production. From the fuel's nascent usage, powering the Industrial Revolution's steam engines, to meeting the current energy needs of a mobile phone wielding, tech-savvy generation, coal has played a huge role in shaping the modern world's energy use. Coal is the most abundant conventional fossil fuel on the planet and accounts for two thirds of the global fossil fuel resource base.⁵ Factor in its relatively low costs, balanced geographical and political distribution, substantial energy density and the world's insatiable appetite for electricity and you have an ostensibly perfect fuel for a ready-made market.

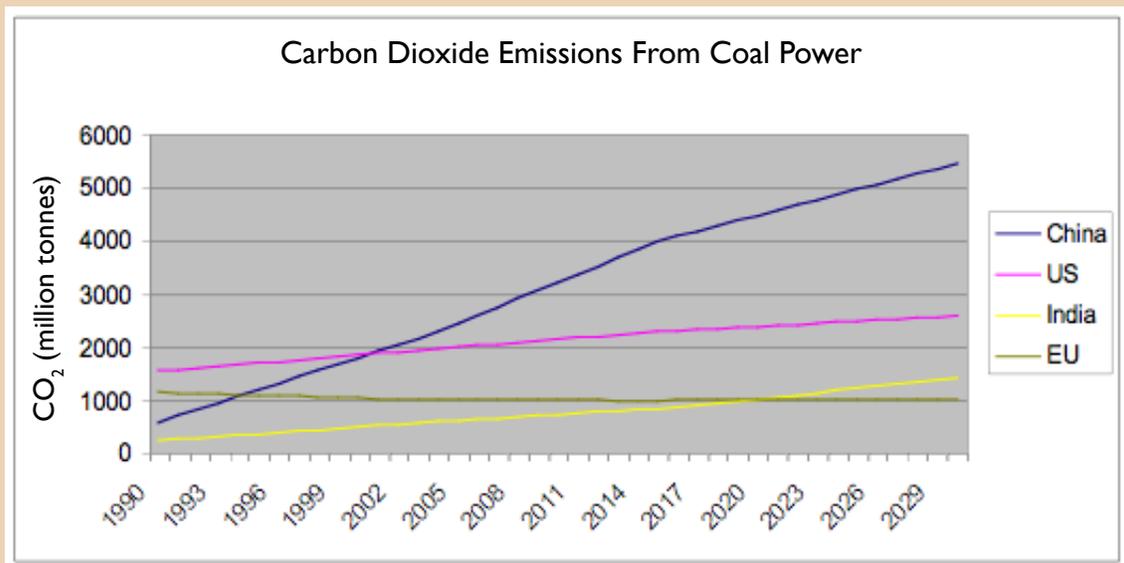
In the last five years, coal use around the world grew by an unprecedented 30 percent; of this increase 88 percent came from developing Asia. China has the biggest share of growth, and is responsible for 72 percent of the world increase

in coal since 2001. India accounts for 9 percent of the world's growth, and the economies of South East Asia and Korea make up the region's balance.⁶



But there is a dark underbelly to this convenient fuel that reveals it to be one of the most polluting energy sources used today. The life cycle of mined coal, from extraction to combustion, severely disrupts ecosystems, contaminates water supplies, emits noxious chemicals such as sulfur dioxide (SO₂), nitrogen oxide (NO_x), carbon dioxide (CO₂) and mercury and provokes a multitude of serious health problems. And what's worse is that beyond coal's more obvious environmental impacts and threats to human health are the irreparably damaging effects of CO₂ emissions. Burning coal for electricity produces about 1 tonne of carbon dioxide for every megawatt hour of energy—twice the greenhouse gas pollution of gas-fired electricity. Coal is the dominant source of global CO₂ emissions, and in 2004 it was responsible for 41 percent of total global emissions.⁷ And if current rates of use continue, coal burning will remain the driving force behind global warming.

Both industrialized and developing nations in the AP region are heavily reliant upon coal as an energy source, and are suffering the consequences of such a dependency. The AP region is home to the world's biggest coal producer and consumer, China. In 2005, China consumed as much coal as the US, Russia, India and Australia combined.⁸ China, Australia and India rank first, third and fourth in the world for coal production. As rapid economic development sweeps across the AP region, particularly in China and India, the demand for energy is growing with equal vigour, and with it so are threats to human health and the environment. The AP region is at a critical moment with regard to coal use, and is grappling with the difficult question of how to balance burgeoning energy needs with the well being of the planet and local communities.



CO₂ emissions from coal power are on the rise in the emerging economies of China and India. (Source: IEA World Energy Outlook 2006)

⁵ Natural Resources Defense Council, "Coal in a Changing Climate," February, 2007.

⁶ BP Statistical Review of World Energy, June 2007.

⁷ International Energy Agency, World Energy Outlook, 2006

⁸ Energy Foundation, "The True Social Cost of Coal: The external cost for the exploitation and utilization of coal in China: a preliminary study," 2006.

Cheap Coal:

The World's Most Expensive Bargain?

Coal's market price reflects various cost elements including mining, production, transportation and retailing costs, government levied taxes and fees, and profit, and the relationship between supply and demand.⁹ But this pricing system ignores some of the biggest costs of coal use: the local and global environmental and social impacts accrued by the exploitation, transformation, transportation and utilization of coal. Because the current market price of coal does not reflect the value of ecological and social resources implicit to the exploitation and use of coal, they are, in economic terms, external to the market price. Tragically, such external costs often wind up being "paid" by those communities subject to coal-generated pollution, in the form of degraded natural resources and health problems. According to a World Bank study, health effects from air pollution (primarily generated by coal burning) will cost China US \$39 billion in 2020, accounting for 13 percent of its GDP.¹⁰ And as the world's need for coal-fired power plants grows, coal's future debts will far outweigh present ones, particularly when it comes to global warming. According to the 2006 Stern Review on the Economics of Climate Change, climate change costs could reach 5 to 20 percent of the global GDP by 2100.



⁹ Energy Foundation, "The True Social Cost of Coal: The external cost for the exploitation and utilization of coal in China: a preliminary study," 2006.

¹⁰ Ibid.

Hidden Costs of Coal

WORKER SAFETY

The electricity used to brew an innocuous morning cup of coffee can likely be traced all the way back to coal mines, found either near the land's surface, or deep underground. Removing coal from the earth is an arduous, dirty and dangerous process. Mining accidents, mine fires, inadequate working conditions and labour disputes are inherent to the coal sector.¹¹

China's coalmines have a demonstrably poor record when it comes to worker safety. In 2005, China's coal sector employed 7.8 million people, produced 40 percent of the world's coal and accounted for 80 percent of the total deaths in coalmine accidents worldwide.¹² In that year alone, according to official figures there were 3,306 accidents in Chinese coalmines, leading to 5,938 deaths. The following year, 4,746 mining deaths were reported.

Mining conditions in India are also often grim. In a report on labour conditions in an underground mine in Katras, India, the Asian Monitor Resource Center detailed a litany of safety offences, including lack of proper safety equipment; inadequate lighting, rendering areas of the mine pitch-black; gas and heat saturated mines, causing miners to strip down to their underwear to cope with temperatures; no proper toilets, creating an intolerable stench from makeshift bathrooms; and most pervasive of all, severe water shortages, that often result in life-threatening dehydration, or consumption of polluted water.¹³

If a coal miner survives the perils of unsafe mines, he faces the threat of pneumoconiosis, or black lung, a chronic disease caused by repeated exposure to coal dust and other small particles stirred up during coal mining. In China there are currently 600,000 black lung patients, and 1,167 new cases and 163 deaths per year from the State-owned coal sector alone. But given the much shoddier, and often unregulated working conditions in small, illegal coalmines, the actual incidence of the disease is likely to be much higher than these figures suggest.¹⁴

¹¹ Bharath Jairaj and Sriharini Narayanan, "Public Participation and Development Case Study of India's Environment Policy Making," 2006.

¹² Natural Resources Defense Council, "Coal in a Changing Climate," February, 2007.

¹³ Asian Labour Update, <http://www.amrc.org.hk/4508.htm>, 2002.

¹⁴ Energy Foundation, "The True Social Cost of Coal: The external cost for the exploitation and utilization of coal in China: a preliminary study," 2006.



LAND

Coal is extracted either through underground mining or surface mining, also known as opencast or opencut mining. Ninety-five percent of China's coal comes from underground mining.¹⁵ During this process coal is dug from deep in the earth, oftentimes through a process called longwall mining, that leaves behind empty mines which are prone to collapsing, causing the land above to sink. When the land subsides, it can cause serious structural damage to homes, buildings and roads, as well as lower the water table and change the flow of groundwater and streams.

The China Daily reports that mazes of underground mining tunnels have caused one-seventh of the land in Shanxi province to subside, and that 400,000 people have lost land, shelter or jobs due to land subsidence.¹⁶ By 2005, 700,000 hectares of land in China had subsided due to coal mining, causing more than \$6.2 billion US in economic losses,¹⁷ and 94 square kilometers more subside each year.¹⁸ Coal mining in China has destroyed 4 million hectares of land, and 46,000 hectares are added to that figure each year. A mere 12 percent of this land has been reclaimed.¹⁹ About 1,900 villages and over a million people have been negatively impacted by geologic disasters caused by coal mining, including ground subsidence, disturbance and "debris flows," which are rivers of rock, earth, and other debris saturated with water.²⁰



Coal mining in China has destroyed 4 million hectares of land, and 46,000 hectares are added to that figure each year.

India favors opencast mining, which accounts for 86 percent of its coal production. Opencast mining requires the exploitation of large tracts of land, and brings with it its own slew of environmental impacts, such as loss of vegetation and tree cover, erosion, dust pollution, depleted forest cover and biodiversity, and pollution of surface water bodies. Such impacts have led to protests in many parts of India, including Uttaranchal, Orissa and Jharkand.²¹

Once coal is mined, large piles of waste materials cast aside when coal is extracted from ore can form chemically unstable, toxic mountains. Coal waste has the potential to spontaneously combust, leading to SO₂ emissions, and rainwater runoff from piles of coal waste contaminates groundwater.²² China's total stock of coal waste reached 4 billion tons in 2005, and covered 12,000 hectares of land.²³

¹⁵ Natural Resources Defense Council, "Coal in a Changing Climate," February, 2007.

¹⁶ http://www.rthk.org.hk/rthk/news/englishnews/20050829/20050829_56_250734.html

¹⁷ Natural Resources Defense Council, "Coal in a Changing Climate," February, 2007.

¹⁸ Energy Foundation, "The True Social Cost of Coal: The external cost for the exploitation and utilization of coal in China: a preliminary study," 2006.

¹⁹ Natural Resources Defense Council, "Coal in a Changing Climate," February, 2007.

²⁰ Energy Foundation, "The True Social Cost of Coal: The external cost for the exploitation and utilization of coal in China: a preliminary study," 2006.

²¹ WWF India and The Energy Research Institute (TERI), "The State of Coal", 2007

²² Energy Foundation, "The True Social Cost of Coal: The external cost for the exploitation and utilization of coal in China: a preliminary study," 2006.

²³ Ibid.



WATER

In addition to terrestrial impacts, mining has calamitous effects on surface and underground water reserves, and local watersheds, including lakes, rivers, streams and coastal areas. For every ton of coal produced, 2.54 tons of water is polluted. Based on an annual production of 2.2 billion tons of coal, this means that 5.6 billion tons of water will be polluted each year.

In both underground and surface mining, sulfur-bearing minerals common in coal mining areas are brought up to the surface in waste rock. When these minerals come into contact with rain and groundwater, an acid leachate is formed. This leachate picks up heavy metals and carries these toxins into streams or groundwater.²⁴ This form of contamination is known as acid mine drainage (AMD). AMD contamination renders water non-potable, harms plants, animals and humans, and can corrode structures like culverts and bridges.

Coal “washing,” the process used to ready coal for burning, is another major source of water pollution. Coal washing is a resource intensive process, which is a serious concern in a country such as India, where water is scarce and often the lifeblood of local communities. Once used for washing, water becomes highly polluted with heavy metals and fine particulate matter, which makes disposal a problem and can cause serious harm to the local environment, especially when effluents are discharged into water bodies. This has been a major problem for the Damodar river in Jharkand and West Bengal.²⁵

Coal generated water pollution is also a major issue for China, a nation in the throes of a severe water crisis—World Bank research estimates that more than 400 of China’s 600 cities have inadequate fresh water supplies and about 100 face serious water shortage problems.²⁶ Pollution from coal mining is compounding an already dire situation—coal mining is responsible for 25 percent of China’s total wastewater discharge. This pollution is concentrated in the major coal mining areas of Shanxi, Shaanxi and Inner Mongolia, where it has caused irreversible damage to the region’s ecology.²⁷

Watersheds in coastal areas used by coal-fired plants as cooling water also suffer severe damages to their aquatic ecosystems. A Clean Air Task Force report titled “Wounded Waters” details potential damages:

- Incidental capture of fish and shellfish species from cooling water intakes, with resultant damage to fish populations and economic fishing losses;
- Alteration of water levels and flows in ways that can be damaging to plant and animal communities;

- Discharge of water at temperatures as much as 15.6 degrees Celsius hotter than the water body from which it came, threatening aquatic ecosystems that cannot sustain such temperature shock;
- Discharge of toxic chemicals used not only to keep cooling water usable but also to support boiler operation as part of waste treatment.

The Machi fishermen in Dahanu, Maharashtra State, India have suffered tremendous resource loss from the effects of cooling water intakes. These fishermen point to the hot water discharge from coal plants as the cause of severe declines in fish and prawn catches. One fisherman attests, **“In the last 4-5 years, fish catches have declined by about 75 percent. Some fish like nevit (cat fish) and boi (mudskippers) and lobster have almost disappeared.”**²⁸

The continuous flow of hot water is causing the northern banks of the Dahanu creek to erode and fishermen are no longer able to lay their nets in those areas. When water at the inlet and outlet points of the plant were tested, the temperature of discharge water was often higher than the permitted limit of 5 degrees Celsius.²⁹



²⁴ Natural Resources Defense Council, “Coal in a Changing Climate,” February, 2007.

²⁵ WWF India and The Energy Research Institute (TERI), “The State of Coal, 2007

²⁶ Development Research Group, World Bank, Zmarak Shalizi, “Addressing China’s Growing Water Shortages and Associated Social and Environmental Consequences,” April, 2006.

²⁷ Natural Resources Defense Council, “Coal in a Changing Climate,” February, 2007.

²⁸ Romana P. de los Reyes, “Impacts of Coal Plants on Communities,” June 2006.

²⁹ Ibid.

AIR

Add air pollution to coal's impacts on human health and terrestrial and aquatic environments, and in monetary terms, you have a growing and unwieldy bill. Coal burning produces vast quantities of toxic air pollutants such as particulate matter, NO_x, SO₂ and mercury, that cause respiratory ailments, cardiovascular illnesses, brain damage, coronary heart disease and can lead to premature death. Coal burning also releases massive amounts of heat-trapping CO₂, the main contributor to global warming. And according to the US Environmental Protection Agency, China's air pollution is on the move—high levels of mercury deposition, traceable to China, have been detected on the east and west coasts of the US, which has prompted the US to assist the Chinese in conducting mercury emissions inventories on polluting industries.³⁰

Pulmonary disease, which is linked to air pollution from activities like coal burning, is the second largest single cause of adult deaths in China (13.9 percent of the total), and an estimated 400,000 people die each year in China from SO₂ emission-related illnesses.³¹ Particulate matter leads to 50,000 premature deaths and 400,000 cases of chronic bronchitis a year in the 11 largest cities in China alone.³² In 2005, China led the world in SO₂ emissions, and was responsible for releasing more than 25 million tonnes, 90 percent of which was generated by coal combustion. Acid rain, a product of SO₂, falls on approximately 30 percent of China's landmass, causing US \$13.3 billion of damage each year.³³

Thailand also grapples with the problem of SO₂ emissions. In one of the more life-threatening instances of SO₂ contamination, more than 1,200 residents of the Mae Moh district in Lampang, Thailand were hospitalized in 1992 after a local plant spewed excessive levels of SO₂. During the same event, plants withered overnight and livestock fell ill. In 1998, another severe emissions episode induced respiratory problems in 600 villagers, and caused damage to crops, vegetables and fruit trees, as well as the death of livestock. In 2004 the Provincial Court of Lampang, Thailand fined the Electricity Generating Authority of Thailand (EGAT) seven million baht for crop damages caused by the coal plant in two villages. Despite such atrocities, the polluting plant remains open, and continues to harm local residents—according to Thailand's Patients Rights Network Against Pollutants, more than 10,000 Mae Moh residents in 17 villages within a 20 kilometre radius of the coal power plant and mine complex suffer from respiratory problems.³⁴ By 2004 there were over 200 respiratory related deaths attributed to coal burning reported in Mae Moh.³⁵



³⁰ Andrew Yeh, *Financial Times*, "Toxic Chinese mercury pollution travelling to US," April, 12, 2006.

³¹ Natural Resources Defense Council, "Coal in a Changing Climate," February, 2007.

³² Energy Foundation, "The True Social Cost of Coal: The external cost for the exploitation and utilization of coal in China: a preliminary study," 2006.

³³ Natural Resources Defense Council, "Coal in a Changing Climate," February, 2007.

³⁴ Romana P. de los Reyes, "Impacts of Coal Plants on Communities," June 2006.

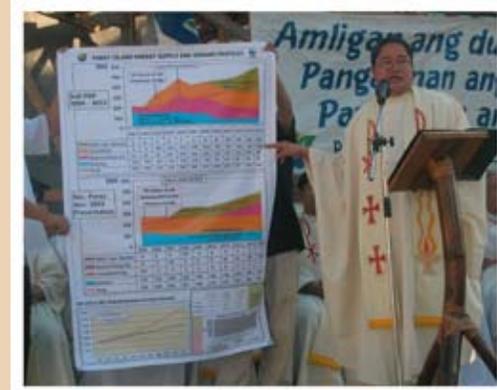
³⁵ *Ibid.*

COMMUNITIES

Communities living either with, or in close proximity to coal mines or coal plants receive the brunt of the industry's negative impacts. Coal generated pollution often destroys natural resources that once sustained local communities, and consequently the land becomes unfit for human habitation. In some instances, entire communities are uprooted and relocated. The Coal Vision 2025 Document of India's Ministry of Coal reveals that about 170,000 families involving about 850,000 people will be affected by coal projects by the year 2025.³⁶

Developing countries are particularly vulnerable to industry negligence with regard to environmental and social issues. In the Philippines, case studies reveal that poverty stricken families, used to living hand-to-mouth, are sometimes cajoled by coal plant proponents and village officials into hosting mines and plants, with promises of jobs and increases in community income, and misled into believing that coal development impacts will be minimal or insignificant. If locals are not sold on this socio-economic dream, they are sometimes pressured into concession. But all too often residents' concerns are validated once projects are approved, and the grim reality of life with coal sets in. Generally, outsiders are brought in to work, and very few locals are offered employment. And once the plant is active, natural resources are often significantly depleted.³⁷

In 1998 in Pulpandan, Philippines, the local community decided to oppose a proposed coal plant based on its perceived negative impacts on public health and the local environment, as well as on the grounds that there were cleaner and cheaper energy alternatives available. But police prevented local activists from attending public forums and distributing posters that challenged the coal plant, and the town mayor threatened to withhold students' monthly allowance if the plant was not approved. When bullying failed to prove effective plant proponents encouraged the "dole-out mentality," by providing cash or in kind donations for various village and town/city activities and projects, including fiesta celebrations, sports events, beautification projects, feeding programs for children, and activities for sectoral groups such as the youth, the elderly and women. Proponents also gave donations for rites of passage celebrations such as birthdays, weddings, anniversaries and death. Such donations were government sanctioned. Existing Philippine regulations allow plant proponents to spend funds to gain social acceptability for their project—they can then deduct these expenses from the government required financial benefit that coal plant owners must legally bestow upon host communities.³⁸



In Iloilo, the Catholic church joined the professionals, academics and environmentalists in disputing the Philippine government's inflated energy projections, which were used to justify building a coal plant.

³⁶ WWF India and The Energy Research Institute (TERI), *The State of Coal, 2007*

³⁷ Romana P. de los Reyes, "Impacts of Coal Plants on Communities," June 2006.

³⁸ *Ibid.*

Luzon, Philippines

Farmers in the Southern Tagalog region of Luzon, Philippines once enjoyed an agrarian lifestyle, cultivating rice, mangoes, coconuts and vegetables. But when coal plants arrived in their verdant coastal communities, century old mango trees were cut down to make way for the plant, and some farmers were forced off their land. Those who weren't displaced reported smaller crop yields and sickly plants. One farmer lamented:

Wind carrying ash from coal plants settles on our crops and severely stunts their growth... We are slowly being ruined. The string beans from our vegetable patch no longer grow in their usual size.³⁹

Locals dependent upon the rich coastal waters to earn a living and feed their families have suffered as well. One fisherman detailed the tragic effects the Mauban coal plant has caused:

Since the plant was built, I've experienced pulling up my crab-nets and finding all my crabs black and strange looking. When coal spills out of their stockyard, which is often, the villagers go to the coast to sweep the carbon off the beach. Some give the carbon back to the coal plant while others just try to bury them under the sand. It's sad. Initially I thought someone was just cleaning squid. Then I noticed the water getting darker and darker... when I go out of the house, I see black water overflowing from the plant site.⁴⁰



Unfortunately, in developing countries, these are not isolated incidences. In many cases, impoverished rural residents often lack the education and resources to stave off the pressure from coal project proponents, who frequently have the full support of local government officials. However, it's not only developing nations who succumb to pressure from the coal industry, and the economic allure of coal. In countries like Australia, where coal exports generate billions of dollars for global coal mining corporations and generate vast tax revenues, coal has become a "resource curse" that distorts local and national economies and communities in a hyped-up development paradigm that threatens sustainability in Australia itself as well as countries locked into Australian coal exports.⁴¹

³⁹ Romana P. de los Reyes, "Impacts of Coal Plants on Communities," June 2006.

⁴⁰ Ibid.

⁴¹ Geoff Evans, "Coal Mining and Development in Australia," August, 2006.

The Hunter Valley - Coal Capital of Australia

The Hunter Valley was formerly touted as Sydney's breadbasket, producing vegetables, wheat, milk and meat for Australia's largest city. Today there are more than 30 coalmines in the Hunter Valley region, and six power stations, generating 40 percent of Australia's electricity. With the price of coal doubling to over Australian \$65 per ton in the past few years, the region has witnessed a "coal rush."

Camberwell, in the heart of the Hunter Valley's dairy and beef cattle farming area, is a typical mine-affected agriculture village. For almost a century Camberwell was home to hundreds of farming families, but over the past ten years open-cut mines have surrounded the village. Walls of mine waste and rubble, towering 100 metres high, block views up the valley. Land acquisition by coal companies, and the constant noise, dust, traffic, and disturbance from blasting operations has forced many families to leave the community they have been part of for generations. Academic researchers investigating social health in the region have found serious levels of distress amongst local residents that manifests itself in a wide range of psychological illnesses, including grief and depression.⁴²



⁴² Geoff Evans, "Coal Mining and Development in Australia," August, 2006.

Global Warming

Global warming has been described as the greatest environmental challenge facing the world this century. Scientists attribute the planet's increasing temperature to excessive amounts of greenhouse gases (GHGs) trapped in the atmosphere, which are largely caused by the global economy's dependence on fossil fuels.⁴³ The average global temperature is now 0.74°C higher than it was in 1850, the point at which reliable temperature records became available. According to IPCC data, eleven of the last twelve years, from 1995 to 2006, are among the twelve warmest years on record.



Research indicates that as the planet's thermostat rises, so will sea levels, potentially flooding coastal areas—global sea level has already risen four to eight inches in the past century. Scientists' best estimate is that sea levels will rise an additional 19 inches by 2100, and perhaps by as much as 37 inches.⁴⁴ This magnitude of change will cause loss of coastal wetlands and barrier islands, and a greater risk of flooding in coastal communities.⁴⁵ Such floods could displace as many as 100 million people.⁴⁶

While some areas of the world will have too much water, others will have too little—hotter temperatures will generate intense heat waves and droughts, causing wildfires, exacerbating air pollution and spreading tropical diseases. If average global temperatures reach 2°C higher than pre-Industrial Revolution levels, it is predicted that worldwide more than three billion people could be at risk due to water shortages; increased droughts in Africa and elsewhere will lead to lower crop yields; and three hundred million people will be at greater risk of malaria and other vector and water-borne diseases.⁴⁷ These drastic environmental changes are expected to disrupt ecosystems and result in significant loss of biodiversity. The first comprehensive assessment of the extinction risk from global warming found that more than one million species could be committed to extinction by 2050 if global warming pollution is not curtailed.⁴⁸

Coal is the most carbon intensive fuel used in energy production and is the dominant source of human CO₂ emissions. Coal related CO₂ increased by 31 percent between 1990 and 2004. If left unchecked global coal related emissions will increase 63 percent by 2030⁴⁹, compared to required greenhouse gas reductions in the order of 60 to 80 percent by 2050 to keep climate change to manageable levels.⁵⁰



⁴³ WWF International, "Climate Solutions: The WWF Vision for 2050," 2007.

⁴⁴ Natural Resources Defense Council: <http://www.nrdc.org/globalWarming/fcons.asp>

⁴⁵ Ibid.

⁴⁶ Stern Review on the Economics of Climate Change, 2006.

⁴⁷ WWF International, "Climate Solutions: The WWF Vision for 2050," 2007.

⁴⁸ Natural Resources Defense Council: <http://www.nrdc.org/globalWarming/fcons.asp>

⁴⁹ International Energy Agency, *World Energy Outlook, 2006*.

⁵⁰ WWF International, "Climate Solutions: The WWF Vision for 2050," 2007.

The True Cost of Coal in China

When one considers the environmental and social costs of the coal industry, including mining accidents, respiratory diseases, loss of land, contaminated water supplies, air pollution and resulting acid rain damage, degradation of community resources and GHG emissions, it becomes apparent that the market value of coal is far below the fuel's actual costs. The China Sustainable Energy Program (CSEP) of Energy Foundation recently sought to calculate by exactly how much.

To put a price tag on coal in China, the CSEP conservatively evaluated the external costs of impacts to human health and the environment caused by coal mining and combustion; calculated the various increases in costs that would be required to make the coal industry more sustainable, including adequate insurance for mine workers, funds for sustainable development and environmental treatment, and rationalization of the resource tax system; assigned a value to climate change impacts of coal extraction; and added in existing costs of production, transport and retailing of coal. Under this evaluation, the true social cost of coal in China in 2005 was determined to be at least 56 percent higher than its market price.⁵¹

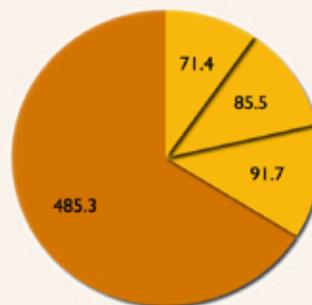
The study also factored in the likely increase in the external cost of coal by 2010 and 2020, based on predictions of GDP growth, increases in coal production and consumption and discharge of air and water pollutants and greenhouse gases.⁵² Using these figures, the CSEP study estimates that the external cost of coal will reach at least 2.4 percent of China's GDP in 2010 and 2.8 percent in 2020, at which time China will consume around 3.5 billion tons of coal.⁵³

According to research by the CSEP, the external cost of coal will reach at least 2.4 percent of China's GDP in 2010 and 2.8 percent in 2020.

It is important to note that these estimates were determined based upon research results from a number of published and unpublished articles and the study was only able to take into account part of the true external costs because the available data is limited. **Therefore these preliminary findings are not comprehensive, and in fact underestimate the true cost of environmental and social damage caused by coal use.**⁵⁴

True Cost of Coal: 733.9 RMB/ton

- Conventional Costs (RMB/ton)
- External Costs include (RMB/ton)
 - external costs of coal mining
 - social costs of coal production
 - external costs of coal burning



For a more detailed breakdown of the costs, please see Annex I

⁵¹ Energy Foundation, "The True Social Cost of Coal: The external cost for the exploitation and utilization of coal in China: a preliminary study," 2006.

⁵² Ibid.

⁵³ Ibid.

⁵⁴ Ibid.

China and India's Coal Demands Heat up the Problem of Global Warming

China and India are coal behemoths, both in terms of production and consumption. In 2006, more than 2.3 billion tons of coal, nearly 40 percent of the world's total, were mined from these two countries.⁵⁵ According to IEA projections, aggressive economic growth in India and China will cause coal consumption in these countries to more than double by 2030. This dramatic rise in coal use will bring about sharp and rapid increases in CO₂ emissions. In 2006, China was reported to have surpassed the U.S. as the world's number one CO₂ emitter, with approximately 8 percent higher emissions than the U.S.—and India lags only a handful of places behind China, as the globe's fifth biggest CO₂ emitter.⁵⁶



With 11.6 percent of the world's total coal reserves, China is predicted to dominate the world's coal industry for generations to come.⁵⁷ According to IEA projections, aggressive economic growth in India and China will cause coal consumption in these countries to more than double by 2030. This dramatic rise in coal use will bring about sharp and rapid increases in CO₂ emissions. In 2006, China was reported to have surpassed the U.S. as the world's number one CO₂ emitter, with approximately 8 percent higher emissions than the U.S.—and India lags only a handful of places behind China, as the globe's fifth biggest CO₂ emitter.⁵⁸

In India, coal presently meets about two thirds of the country's commercial energy needs, and is the core of the energy sector.⁵⁹ India has an annual production yield of over 400 million tonnes,⁶⁰ and reserves sufficient to cover projected demands for the next 250 years.⁶¹ (Although contradicting

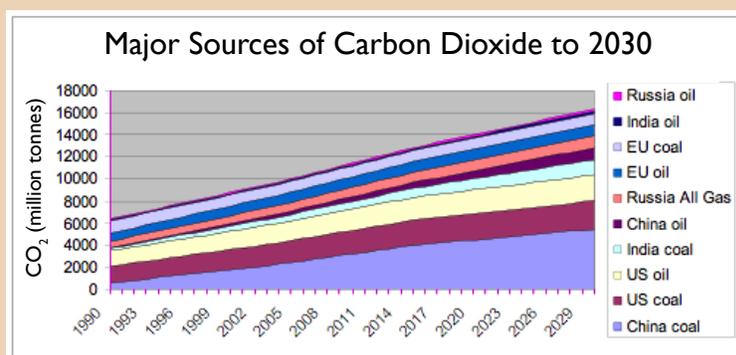
	Global	China	India
Coal demand 2006 ⁶² (mtoe ⁶³)	3090	1191	238
Percentage increase in coal use 2001 - 2006 ⁶⁴	30%	75%	38%
Projected percentage increase coal demand 2004 - 2030	60%	107%	142%
2004-2030 increase as percentage of world total increase in coal use		72%	9%
Emissions from coal use as fraction of global CO ₂ emissions 2004		15%	3%
Emissions from coal as fraction of projected global CO ₂ emissions in 2030		20%	4%
Power generation as a percentage of coal use in 2004	68%	57%	75%
Power generation as a fraction of increase in coal use 2004 -2030	81%	74%	82%

(Source: IEA World Energy Outlook 2006)

reports predict that India's coal reserves will hold out only for 45 years at 5 percent growth in consumption. And even this figure is viewed by some experts as an optimistic assessment.⁶⁵) However, coal production in India necessitates significant relocation costs. Most coal reserves in India are either in forest areas or river basins, that have high ecological and agricultural value, and equitable land sites for displaced communities are costly and difficult to find, which may inhibit future coal production.⁶⁶

The challenge for China and India is to achieve economic development without inflicting more damages upon the local environment and communities, or wildly exacerbating the problem of global warming. If China and India choose to mitigate coal's impacts, they will accomplish the two-fold task of curbing global warming and reducing coal's impacts on human health. Because burning of fossil fuels is linked to both climate change and air pollution, reducing the amount of fuel combusted will lead to lower carbon emissions, as well as minimize the impacts to human health and the environment. IPCC data points out that an increasing number of studies have demonstrated significant benefits of carbon mitigation strategies, such as improved air quality in cities and reduced levels of regional air pollutants.⁶⁷

Mitigation strategies aiming at moderate reductions of carbon emissions in the next 10 to 20 years (typically involving carbon dioxide reductions between ten and twenty percent compared to the business-as-usual (BAU) baseline) also reduce SO₂ emissions by ten to twenty percent and nitrogen oxides and particulate matter emissions by five to ten percent.⁶⁸ Studies calculate that for Asian and Latin American countries, several tens of thousands of premature deaths could be avoided annually as a side effect of moderate CO₂ mitigation strategies.⁶⁹



Coal use in China's and India's power sector are No. 1 and No. 4, respectively, of the 10 biggest sources of carbon dioxide globally by 2030. (Note that 'coal' figures are for power sector only and 'oil' figures are for transport sector only. 'Russia All Gas' is all sectors.) Source IEA World Energy Outlook 2006.

⁵⁵ Natural Resources Defense Council, "Coal in a Changing Climate," February, 2007.

⁵⁶ Netherlands Environmental Assessment Agency

⁵⁷ Energy Foundation, "The True Social Cost of Coal: The external cost for the exploitation and utilization of coal in China: a preliminary study," 2006.

⁵⁸ Natural Resources Defense Council, "Coal in a Changing Climate," February, 2007.

⁵⁹ Bharath Jairaj and Sriharini Narayanan, "Public Participation and Development Case Study of India's Environment Policy Making," 2006.

⁶⁰ International Energy Agency, World Energy Outlook, 2006

⁶¹ BP Statistical review of world energy, 2007. www.bp.com

⁶² Ibid.

⁶³ Million tonnes of oil equivalent

⁶⁴ BP Statistical review of world energy, 2007. www.bp.com

⁶⁵ WWF India and The Energy Research Institute (TERI), "The State of Coal", 2007

⁶⁶ Ibid.

⁶⁷ IPCC, 2007. Climate change 2007: Mitigation. Contribution of Working group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O. R. Davidson, P. R. Bosch, R. Dave, L. A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

⁶⁸ Ibid.

⁶⁹ Ibid.

Making a rapid transition to low emissions technologies will entail an increase in short run capital costs, particularly if external costs of coal are not internalised. This in turn implies an increase in energy costs to consumers, which is a tough political sell in emerging economies with booming populations.

If low emissions technologies are to be introduced immediately to avoid dangerous climate change, then new forms of technology transfer will be required. Industrialized countries in particular will be required to step up to the plate and provide support for technologies that are developed within their borders to be deployed quickly and affordably across the AP region.

Cleaning Up Coal

While it is crucial that China and India shift to less carbon intensive fuels, pursue renewable energy, and practice greater energy efficiency, these countries' immediate energy needs, coupled with massive coal reserves, ensure their continued dependency on this fuel—at least until accurate pricing and regulations curb its use.

In order to address the environmental problems implicit to the continued use of coal, it is critical that immediate measures be taken to mitigate pollution through adoption of low emissions technologies, such as supercritical and ultra-supercritical power stations, Integrated Gasification Combined Cycle (IGCC), and Carbon Capture and Storage (CCS). Supercritical, ultra-supercritical and IGCC have the potential to dramatically reduce local air pollutants, such as mercury, sulfur, and nitrous oxides. But CCS is the only low emission technology that holds any promise for mitigating CO₂ emissions, and it has yet to be proven viable on a commercial scale.

Supercritical and Ultra-supercritical Power Plants

Supercritical and ultra-supercritical power plants are older, more mature examples of advanced coal technology. These plants operate at temperatures and pressures above the critical point when steam begins to decrease in density. They are 45 percent and 50 percent, respectively, more efficient than traditional coal-firing plants, and produce significantly lower emissions.⁷⁰ According to the London-based World Coal Institute, more than 240 high efficiency supercritical units are in use worldwide, including 22 in China; 24 ultra-supercritical units operate in Europe and the US.



⁷⁰ The World Coal Institute: http://www.worldcoal.org/assets_cm/files/PDF/clean_coal_technologies_summary.pdf

Are China and India getting wiser with their coal use?

In January 2007 it was reported that Shanghai recently opened one of China's most advanced supercritical plants. Phase two of the Waigaoqiao plant has net efficiency of more than 42 percent, versus the worldwide average of 35 percent⁷¹ for hard coal-fired units, and will save an annual one million tons of coal and reduce carbon dioxide emissions by 2.1 million tons in comparison with a typical Chinese power station of the same size. In late 2006, China's Huaneng Group, the nation's biggest electricity producer, successfully completed performance tests of China's first ultra-supercritical coal-fired power station in east China's Zhejiang province. Huaneng is investing \$1.2 billion in the two 1,000MW generating units, which it says will use the world's most advanced coal-fired power generating technology.⁷²



India currently has no supercritical or ultra-supercritical plants in operation, but is building the foundation for such advancements. In April 2006 the Siemens Power Generation Group and the Indian firm Bharat Heavy Electricals Ltd. (BHEL) of New Delhi signed a memorandum of understanding on cooperation in the field of advanced power plant technology for clean conversion of coal to electricity. The agreement makes provision for BHEL and Siemens to jointly offer and execute power plant projects in India that involve so-called supercritical steam conditions.⁷³ Along with the MOU, in April 2007 Mitsubishi Heavy Industries signed an agreement with Larsen & Toubro Limited (L&T), a major engineering and construction firm in India, to jointly establish a company to manufacture and sell supercritical pressure boilers, which are used in coal-fired power generation plants.⁷⁴



These existing and planned supercritical and ultra-supercritical plants represent a small victory for the environment, but much work remains to bring next generation technologies to market.

⁷¹ EIA, "Energy Technology Perspectives," 2006.

⁷² <http://www.ethicalcorp.com/content.asp?ContentID=4782>

⁷³ <http://www.powergeneration.siemens.com/en/press/pg200604035el/index.cfm>

⁷⁴ <http://www.bloomberg.com/apps/news?pid=conewsstory&refer=conews&tkr=7011:JP&sid=akJYjLhgBGO>

Integrated Gasification Combined Cycle (IGCC)

Supercritical and ultra-supercritical plants are a marked improvement over traditional plants, but emissions continue to be a problem. IGCC, which is considered to be the “next step” up the low emissions technology ladder, improves thermal efficiency of coal combustion and produces concentrated streams of carbon dioxide and hydrogen by gasifying coal prior to combustion. IGCC offers efficiencies of up to 50 percent, with a potential of 56 percent in the future, thereby significantly improving environmental performance.⁷⁵ An IGCC plant needs 10 to 20 percent less fuel than a large-scale standard coal-fired power plant and up to 35 percent less than a small-scale industrial coal-fired power plant. Emissions are greatly reduced, even compared to advanced conventional technologies, with 33 percent reduction in nitrous oxides, 75 percent less sulfur dioxide and almost zero particulate emissions.⁷⁶ IGCC uses 30-40 percent less water than a conventional plant and up to 90 percent of mercury emissions can be captured.⁷⁷ On a conventional cost basis, it is estimated that an IGCC plant is 10 to 20 percent more expensive to build than a conventional plant.



Coal gasification technologies hold the greatest promise for cost effective CO₂ capture on a large scale because the CO₂ is removed before combustion and is therefore readily available for capture and storage. There are currently over 10 IGCC plants in use world-wide, with one to two years operating experience. While the capital cost of an IGCC plant is high, the costs associated with capturing CO₂ from an IGCC plant are much lower than they are for a conventional pulverised coal power station.

Carbon Capture and Storage (CCS)

Carbon capture and storage (CCS) technologies allow emissions of carbon dioxide to be captured and stored, preventing them from entering the atmosphere. CO₂ capture is possible from power stations or potentially other large CO₂ sources, such as chemical, steel or cement industries or natural gas production. CO₂ can be stored in geological formations such as aquifers or expired oil and gas reservoirs.⁷⁸

CCS is touted as the foremost technology to substantially reduce GHG emissions, which holds particular relevance for the heavily coal-dependent AP region. But it remains to be seen whether or not CCS can do this in a way that is financially and environmentally viable on a widespread commercial scale.

There are several large carbon dioxide injection projects currently in operation but even the biggest of those projects, in Sleipner, Norway, only injects one million tons of carbon dioxide per year, while a single large coal power plant can produce about five million tons per year.⁷⁹ But there

⁷⁵ World Coal Institute: <http://www.worldcoal.org/pages/content/index.asp?PageID=422>

⁷⁶ Ibid.

⁷⁷ Ibid.

⁷⁸ World Coal Institute: <http://www.worldcoal.org/pages/content/index.asp?PageID=414>

⁷⁹ Natural Resources Defense Council, “No Time Like the Present,” March 2007.

are concerns as to whether or not injected CO₂ will remain in place for periods of time required to prevent its effects on global warming.⁸⁰ But studies are optimistic to this end. The most recent IPCC climate change report concludes that “observations from engineered and natural analogues as well as models suggest that the fraction retained in appropriately selected and managed geologic reservoirs is very likely to exceed 99 percent over 100 years and is likely to exceed 99 percent over 1,000 years.” But as the Natural Resources Defense Council points out, even with such assurances, a regulatory framework is absolutely necessary to assure that CCS does not pose any significant risk to human health or the environment, to assure it performs to high standards, and to enable widespread adoption of the technology.⁸¹ Assuming effective long-term storage of captured CO₂, around 80 to 90 percent of the CO₂ from a plant fitted with CCS may be prevented from entering the atmosphere.

Although some components of CCS technology have been proven on a commercial scale, a fully integrated CCS system operating in conjunction with a coal-fired power plant has not yet been demonstrated. The first large-scale demonstration coal-fired power stations with CCS include FutureGen in the United States,⁸² due for completion in 2012, and a recently announced “zero emission” plant in Queensland, Australia, to be completed in 2010.⁸³ These projects aim to demonstrate commercial and technical feasibility of coal-fired power stations with integrated CCS within 10 years. Some estimates suggest that broad scale implementation of CCS is unlikely to occur in the next ten to fifteen years, although more optimistic predictions that assume sufficient political support and grant funding, give a time frame of ten years.⁸⁴

But it is important to note that CCS technology is controversial. A study by The Australia Institute⁸⁵ examining the potential of CCS in Australia concluded that CCS fitted to new power stations would have limited capacity to reduce nationwide CO₂ emissions and would be uneconomical both in terms of installation costs and continued operation. Even when discounting the risks inherent to implementation of unproven CCS technology, the costs of CO₂ abatement are lower for several non-CCS alternatives including energy efficiency, natural gas-fired power stations, wind and biomass.

Because CCS is not expected to remove all CO₂ it is not carbon neutral. A theoretical analysis of CCS applied in Australia⁸⁶ concludes that CCS has limits in achieving significant reductions in CO₂ so long as coal-fired electricity generation follows business-as-usual growth projections. Following this logic, China and India’s projected growth will lead to substantial CO₂ emissions even if CCS is widely deployed. The only realistic solution, according to the Australian study, is to gradually reduce the reliance on coal as a primary energy source and embrace alternative forms of low emission electricity generating technology.



⁸⁰ Natural Resources Defense Council, “No Time Like the Present,” March 2007.

⁸¹ Ibid.

⁸² US Department of Energy, 2003

⁸³ AAP Financial News, 26 July 2006; Press release quoting Peter Beattie, Premier of Queensland

⁸⁴ <http://www.bluesci.org/content/view/full/407/385> (accessed June 2006)

⁸⁵ Saddler H, Riedy C, Passey R, 2004. Geosequestration: What is it and how much can it contribute to a sustainable energy policy for Australia?, Discussion Paper Number 72, The Australia Institute.

⁸⁶ Passey RJ & McGill IF (2003) The Australian Electricity Industry and Geosequestration – Some Abatement Scenarios, Destination Renewables – ANZSES.

China's Potential to Leapfrog Technology

China is in a unique position to be a frontrunner in low emissions coal technology. In the spirit of such leadership and quest for innovative low emissions coal technology, the Green Coal Power Company, with shareholders from the top eight state-owned power companies, was founded in China at the end of 2005. US\$714 million was invested into the project, and investors include the country's top five power generators (China Huaneng Group, China Datang Corporation, China Huadian Corporation, China Guodian Corporation and China Power Investment Corporation), the two biggest coal producers (Shenhua Group and China Coal Group) and an investment company (State Development and Investment Corporation). The joint-venture company plans to demonstrate and promote advanced coal power generation technologies with near-zero emissions of carbon dioxide and other pollutants within fifteen years.⁸⁷

China took another step in the right direction in late 2006, when it joined the US Government Steering Committee of the FutureGen project, becoming the third country to join the United States in the FutureGen International Partnership. If such momentum is built upon, and with steadfast interest and adequate funding for research, China, with its voracious energy needs, could place itself on the cutting edge of low emissions coal technology utilisation.

China's first National Climate Change Programme, released in June 2007, can help to fast-track deployment of low emissions coal technologies, as well as drive a raft of new approaches to reducing China's greenhouse gas emissions growth. The Climate Programme incorporates a number of existing pollution, renewables and energy efficiency targets, but it is currently too early to assess its effectiveness.

⁸⁷ WWF International, "Climate Solutions: The WWF Vision for 2050," 2007.



Barriers to Low Emissions Coal Technology

At present, there are several significant, although not impassable, barriers to large-scale implementation of low emissions coal technology in China and India, which range from the technical to the economic and political.

Technical

Low emissions coal technology are either still immature or require huge capital investments, and solutions emerging from one country cannot always be transposed to another. Low emissions coal technology often needs to be adapted to local conditions, and even if the technology is transferable, it is in some cases blocked from use by strong international patents that require hefty licensing fees.⁸⁸

In the case of CCS, the primary technical barriers to large-scale implementation in the AP region is the immaturity of the technology and the associated loss of overall generating efficiency, which raises the cost of electricity generation. A power plant with CCS consumes a significantly greater amount of energy than a plant without CCS, while producing the same electricity output. This is known as the energy penalty. A pulverised coal plant fitted with CCS would use 24 to 40 percent more energy than an equivalent plant without CCS, mostly for CO₂ capture and compression. The energy penalty for an IGCC plant with CCS is estimated to, be 6 to 12 percent, but efficiency may improve as low emissions coal and CCS technologies further develop.⁸⁹

But the most fundamental technical barrier to CCS in China and India at present is the virtual absence of data on the location and capacity of CO₂ storage sites within reasonable distance of coal-fired power stations. In China, potential sites for CO₂ storage have been mapped⁹⁰ on the basis of theoretically suitable geological formations (not actual CO₂ storage capacity). In India, no such studies have been reported to date.

Economic and Political Barriers

Low emissions coal technology is uncompetitive at present in China and India because there has been no internalisation of the external costs of coal. As discussed previously, the price of coal does not reflect the social and environmental impacts generated through its exploitation, production and eventual combustion. In China, external costs have not been fully incorporated in prices and tariffs—such costs could make zero emissions renewables, gas and low emissions coal technology more competitive with older, polluting plants. Without such cost adjustment there is little incentive for investors to back cleaner technologies.



Both China and India lack stringent environmental regulations, and what standards they do have are difficult to enforce. China's rush for economic growth has caused growing pains in her energy-related governmental bureaucracy, and China is struggling to keep up with the demands for energy production, while still adhering to environmental regulations. On the most basic level, China has a fleet of seriously understaffed agencies, some of which are newly formed and notably weak in relation to both other agencies and to the players they are supposed to be regulating.⁹¹ China's State Environmental Protection Agency (SEPA) has about 200 full-time employees, versus 18,000 at the Environmental Protection Agency in the United States. And in the place of an Energy Ministry, China has an Energy Bureau within the National Development and Reform Commission, which is the country's central planning agency and employs just 100 full-time staff members. The US Energy Department, on the other hand, has 110,000 employees.⁹²

One example of the organizational challenges in China's energy sector is the construction of illegal power plants in provinces such as Inner Mongolia. During a year-long investigation in 2005, *The Wall Street Journal* reported that the central Chinese government discovered that Inner Mongolia had illegally built about 10 power plants with 8.6GW of electricity-generating capacity, equal to about a 10th of the United Kingdom's total installed capacity. Such illegal plants eschew even basic environmental safeguards, and officials say they stand out as polluters even in an industry that is one of China's leading sources of emissions.⁹³

Like China, India's primary concern at present is to increase coal production as rapidly as possible, to meet fast-growing energy needs. Placing emission constraints on coal is perceived to make the process slower and costlier, and so India is also reticent to adopt high efficiency and low emissions coal technologies.⁹⁴ It is often the case in India that cheap energy becomes a bargaining tool during yearly elections—political parties try to gain an edge over competitors by offering free electricity to the poorest and least educated citizens.⁹⁵

At present, the Indian government has not developed a formal strategy for GHG mitigation. India's Integrated Energy Policy cursorily addresses climate change and emissions from combustion of coal, but emphasises that India's per capita contribution to global CO₂ emissions is very small compared with most industrialised countries. Conventional pollutants are poorly regulated and this is reflected by India's weak Minimum National Standard regulation, and the poor compliance with these bare-boned regulations—around 43 percent of currently operating thermal power stations in India do not comply with air pollution standards, and 36 percent do not comply with water pollution standards.⁹⁶

⁸⁸ WWF India and The Energy Research Institute (TERI), "The State of Coal", 2007

⁸⁹ Henderson C (2003) Clean coal technologies roadmaps, IEA Clean Coal Centre

⁹⁰ Newlands I, Langford R, Assessment of Geological Storage Potential of Carbon Dioxide in the APEC Region - Phase I: CO₂ Storage Prospectivity of Selected Sedimentary Basins in the Region of China and South East Asia. Innovative Carbon Technologies, Canberra, June 2005.

⁹¹ "Massachusetts Institute of Technology, "The Future of Coal: Options for a Carbon-Constrained World," 2007.

⁹² New York Times, Joseph Khan and Jim Yardley, "As China Roars Pollution Reaches Deadly Extremes", August 26, 2007.

⁹³ Wall Street Journal, Shai Oster, "Illegal Power Plants and Coal Mines Pose Challenge for Beijing", December 27, 2006.

⁹⁴ Manor Sustainability Consulting, "Coal and Development: Global Impacts-Climate Change," 2006

⁹⁵ Ibid.

⁹⁶ Central Pollution Control Board (Government of India), 2005

A Way Forward

This report has revealed the “hidden costs” of coal: its impacts on the AP region’s local environment and communities, and its significant contributions to global warming, against the complicated backdrop of the region’s reliance upon coal to meet burgeoning energy demands, particularly in China and India. The potential and pitfalls of low emissions coal technology and the viability of such technology in the AP region have also been explored. But the question remains if, and how, coal can continue to play a role in the AP region while preserving the local environment, protecting local communities and preventing dangerous climate change.



Addressing Coal’s Local Impacts

For coal to be an environmentally and socially sound source of energy at a local level in the twenty-first century, significant, dedicated measures must be taken to “clean” up the industry, and time is of the essence.

In the AP region WWF recommends the following measures be taken:

- Internalisation of the social and environmental costs of coal production and use
- Immediate deployment of low emission coal technologies to reduce local pollution
- Strengthening of government policies, particularly the Environmental Impact Assessments (EIA), that include civil society in decision-making processes and protect local communities from coal’s negative impacts

Internalising the Social and Environmental Costs of Coal Production and Use

As the old adage goes, money talks. If the price of coal reflected the external costs imposed on society by mining and combustion, investors would be more willing to devote funds to energy efficiency, renewable energy and low emissions coal technology; projects and policies would be developed with more sensitivity to the environment; technology would not be as cost prohibitive; and there would be increased funding for environmental restoration.⁹⁷

Using economic instruments to internalize environmental costs is a widespread practice that has proved to be effective in curbing pollution. Economic instruments, in theory, have all the efficiency properties of competitive market pricing; they trigger actions both among producers and consumers

that allow the achievement of given environmental objectives at the lowest costs. The efficient nature of economic instruments is due to the flexibility given to polluters for devising a cost effective compliance strategy.⁹⁸ Of the different types of economic instruments available, the more commonly used are pollution levies, charges and taxes, and trading permits.

Pollution Levies, Charges and Taxes

This approach assumes that the producer and/or consumer pays when materials or processes are used that cause pollution.⁹⁹ These fees must exceed the cost to clean up industry practices, lest a situation arise in which it becomes cheaper to pollute than to invest in cleaner production techniques. This occurred in China in 1996, when the government began imposing a charge for sulfur dioxide emissions on a trial basis. As the economy developed, the original set price became far lower than the actual cost of treatment for discharges. If fees are properly set, once collected, they can then be used for pollution treatment and ecological restoration.¹⁰⁰



Coal burning in Hong Kong and in the Pearl River Delta is partly to blame for Hong Kong's worsening air quality.

In China, an energy tax, applicable to all consumers of coal, including the manufacturing, power generation and industrial sectors, as well as civil use, could span the gap between coal's current value and its true social cost. Such a tax would be most beneficial if initially levied at the wholesale level, and eventually transferred to the retail level. If enacted, an energy tax would promote energy conservation and provide funding for environmental remediation, thereby improving energy efficiency and bolstering investments in low emissions coal technology.¹⁰¹

Trading Permits

Taxes set a price for pollution and the market decides how much pollution will be cut. Instead of taxing, a government can decide to set a target limit on pollution or resource depletion, and then distribute permits for those activities. In a permit trading system, the market determines the price. A company that is unable or unwilling to live within its limits must buy permits from those who exceed the designated level of compliance.¹⁰²

⁹⁷ Energy Foundation, "The True Social Cost of Coal: The external cost for the exploitation and utilization of coal in China: a preliminary study," 2006.

⁹⁸ Regulatory Assistance Project, "International Experience: Incorporating Environmental Costs in Prices," November, 2002

⁹⁹ Ibid.

¹⁰⁰ Energy Foundation, "The True Social Cost of Coal: The external cost for the exploitation and utilization of coal in China: a preliminary study," 2006.

¹⁰¹ Ibid.

¹⁰² Regulatory Assistance Project, "International Experience: Incorporating Environmental Costs in Prices," November, 2002

Emissions Trading in China

To date, China has completed two phases of emissions trading pilots, and in 2007 embarked on its third, a regional emissions trading pilot between Guangdong in the Pearl River Delta Region and Hong Kong.¹⁰³ A recently released study by Julia Tao et al of Governance in Asia Research Centre at City University of Hong Kong examining China's emissions trading pilot program finds that "to date, a well-functioning emission trading market which operates with high liquidity and low transaction cost is hardly at play in China. Instead, administrative-led transactions, discretionary trading arrangements, thin markets characterized by a small number of potential buyers and sellers, an absence of informative prices, high transaction cost, and an absence of liquidity suppliers are common features of all the pilot project implemented so far."¹⁰⁴

But to a positive end, the study also notes that some market elements of emissions trading have been implemented in China's environmental management system without causing major disruption to the functioning of the power sector, and even with an imperfect trading system, environmental improvements and a higher degree of environmental consciousness have been achieved. The study concludes that "in building a mature emissions trading market, it is clear that China will have to enhance her governance, including rule of law, independent regulation, information disclosure and public accountability, in order to fully utilize the benefit of the market to solve her environmental problems."¹⁰⁵

In a small step towards addressing such issues, in October 2007, Beijing called for all local governments to prepare what is conceivably the largest environmental audit ever undertaken. The State Council said that in 2008 it will collect all the necessary data from industrial, agricultural and residential pollution sources, and according to the council, in doing so will lay a foundation for the country "to substantially reduce emissions in the long run, through not only administrative regulation, but market mechanisms as well."¹⁰⁶



Implementation of Low Emissions Technology

While low emissions coal technology plants are more costly than traditional plants, it is important to point out that they provide a solution that embraces coal as an energy resource, which is important for countries who have abundant coal reserves and are intent upon tapping them. Low emissions coal technology plants are also a crucial component of successful widespread deployment of CCS, as retrofitting traditional inefficient pulverized coal plants is more expensive and complicated than using

IGCC or ultra-supercritical coal plants. If coal's external costs are internalised, potentially through such market mechanisms as described previously, subsequent funding for low emissions technology will make it less cost prohibitive in developing nations.

For low emissions coal technology to be attractive to India and China, as well as other developing countries in AP, appropriate economic and regulatory incentives are critical. The following measures would significantly bolster commitment to advanced coal technology:

- Stricter, and consistently enforced standards and regulations covering the entire life-cycle of coal
- Pricing mechanisms that internalise the impacts of coal use
- Intervention by governments to accelerate technology transfer
- Portfolio standards for low emissions coal technologies

Giving the Public a Voice

“We must understand clearly that public participation is the right and interest of the people endowed by law. The government has the obligation to respond to and to protect this right.”

—Pan Yue, deputy minister of China's State Environmental Protection Agency (SEPA)

For coal development to proceed in an ecologically and socially sustainable manner, and one that instils trust in host communities, then transparent public participation in the decision-making process should be an absolute priority. At present, the Environmental Impact Assessment (EIA) is one way the public can protect itself from unfettered industry development. But the EIA process is inadequate in many countries in the AP region at present, and needs to be refined so as to better protect the environment and public from destructive industry practices. (see *Is EIA Still A Public Platform?*)

This is especially true as governments look to a future that incorporates low emissions coal technology. Massachusetts Institute of Technology's (MIT) report on the future of coal makes the critical point that for technology like CCS to be safe, performed to high standards and suitable for wide-spread adoption, a regulatory framework is absolutely necessary: “An explicit and rigorous regulatory process that has public and political support is prerequisite for implementation of carbon sequestration on a large scale.”¹⁰⁷

¹⁰³ Research project “Transboundary Environmental Governance: A Case Study of Guangdong-Hong Kong Emission Trading Pilot Study” conducted by Julia TAO of the Governance in Asia Research Centre, City University of Hong Kong in collaboration with MA Xiaoling of the South China Institute of Environmental Sciences, State Environmental Protection Administration, PRC, 2004-2006.

¹⁰⁴ Conference paper “Between Market and State: Dilemmas of Environmental Governance in Transitional China” presented by Julia TAO and Daphne MAH at the Second Congress of Asian Political and International Studies Association on Governance Dilemmas in Asia: Public Action in a Competitive and Insecure World, held at City University of Hong Kong, 14-16 November 2005.

¹⁰⁵ Julia TAO, Daphne MAH, and MA Xiaoling, “Evaluation of China's Emission Trading and Prospects of the Pearl River Delta Transboundary Emission Trading Pilot Scheme”, Final Report of the Study on Guangdong and Hong Kong Cross-border Environmental Governance, jointly published by the South China Institute of Environmental Sciences, State Environmental Protection Administration, PRC and Hong Kong Open University, July 2006.

¹⁰⁶ James Ockenden, “HK emissions trading scheme “too small and diverse,” *Blue Skies China*, Dec. 26, 2006

¹⁰⁷ Massachusetts Institute of Technology, “The Future of Coal: Options for a Carbon-Constrained World,” 2007.

Is EIA Still A Public Platform?

By and large, current Environmental Impact Assessment (EIA) policies in the AP region are inadequate in terms of environmental protection, and offer the public very few avenues for accessing information or effecting change. Australia has the most comprehensive EIA but it is still lacking when it comes to legitimately protecting the environment.

Australia: Australia's Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) requires environmental assessment and approval for actions that are likely to have a significant impact on "a matter of national environmental significance." However, the Environment Minister can exempt a person from the requirement to conduct an EIA and/or obtain approval if it is considered in the "national interest" to do so. There are additional regulations on both the state and territory level that aim to understand and assess environmental impacts of development projects but in some instances these processes have been bypassed to fast track the application process for major development projects labelled "critical infrastructure projects" that are significant to the interests of the State. Despite these seeming inadequacies, Australia is still far ahead of less developed countries in the AP region: Australia has several legally established avenues for public participation in environmental decision-making, which include rights of notification or access to information; rights to seek review of decisions; rights to force a government agency to take up an action; and the ability to bring court proceedings to prevent the contravention of rights to participation.¹⁰⁸

China: In October 2003, China's EIA law was upgraded from a subset of the country's Environmental Protection Law to a law in its own right. The new law has been criticised for being weak, and for 'encouraging' rather than 'requiring' action. While EIAs are required to be completed prior to project construction, the only consequence of a failure to do so in China is that the Environmental Protection Bureau may require the developer to do a make-up EIA. If this make-up EIA is not performed the developer is fined an amount that is a fraction of the cost of the development. This creates a loophole around the fundamental purpose of EIA, which is to build environmental considerations into the development of projects and plans before they are completed. The law provides for an open process to enhance public participation in environmental decision-making. However, a report by the World Watch Institute states that because of obstructions to the disclosure and dissemination of environmental information in China, broad public involvement in the EIA process has been limited at best. Public participation is also impeded by the lack of public education and awareness. In 2006, SEPA issued guidelines in an attempt to improve the public participation mechanism. While it is not clear how these Guidelines will address existing gaps and errors in enforcement, environmentalists have lauded the overall objectives of these improvements.¹⁰⁹

¹⁰⁸ Bharath Jairaj and Sriharini Narayanan, "Public Participation and Development Case Study of India's Environment Policy Making," 2006.

¹⁰⁹ Ibid.

India: When India's EIA law was passed in 1994, it gave citizens the right to information about proposed industrial or other activity, and space to express concerns or opinions. It provided for open access to EIA documents, mandatory public hearings, the setting of conditions in environmental clearances and reporting on compliance. However, subsequent amendments have made the EIA process less open and less comprehensive. A number of industry sectors have been exempted from EIA requirements and public access to EIA reports has been limited to the executive summary. There is no access to the technical studies on which the EIA conclusions are based. These EIA documents are only available for inspection at specific government offices, typically far away from the communities in which the projects are proposed to take place, and are not posted on government websites. The latest version of the EIA law, issued in September 2006, was designed to streamline environmental clearance and reduce delays and hassles in order to encourage investment. The new law has reduced the previous requirement for public participation with a formalistic process of "public consultation." The focus of the new EIA law is to ensure "no delays whatsoever," clearly prioritising time limits over the precautionary principle.

Philippines: The process for environmental clearance of projects has been fast tracked since a revision of the Rules relating to the granting of Environmental Clearance in 2003. The processing time frame for a new Environmentally Critical Project (ECP), such as a coal plant, has been limited to 120 days, and for the expansion of an ECP the time period is only 90 days. If no decision has been made within the specified timeframe, the application is "deemed approved" and the approving authority has to issue the Environmental Clearance Certificate within the next 5 days. Avenues for public participation have been reduced to a requirement to solicit and include public inputs in the decision making process. The previous requirement for the Environmental Impact Statement to be publicly posted has been deleted.

Thailand: Thailand's EIA procedure is spelt out in the Enhancement And Conservation Of The National Environmental Quality Act 1992. The EIA procedure is separated into public sector and private sector tracks. While individuals are granted access to project information, this access is not available "where such data or information includes officially classified material ... or secrets pertaining to the rights of privacy, property rights or the rights in trade and business which are duly protected by law."

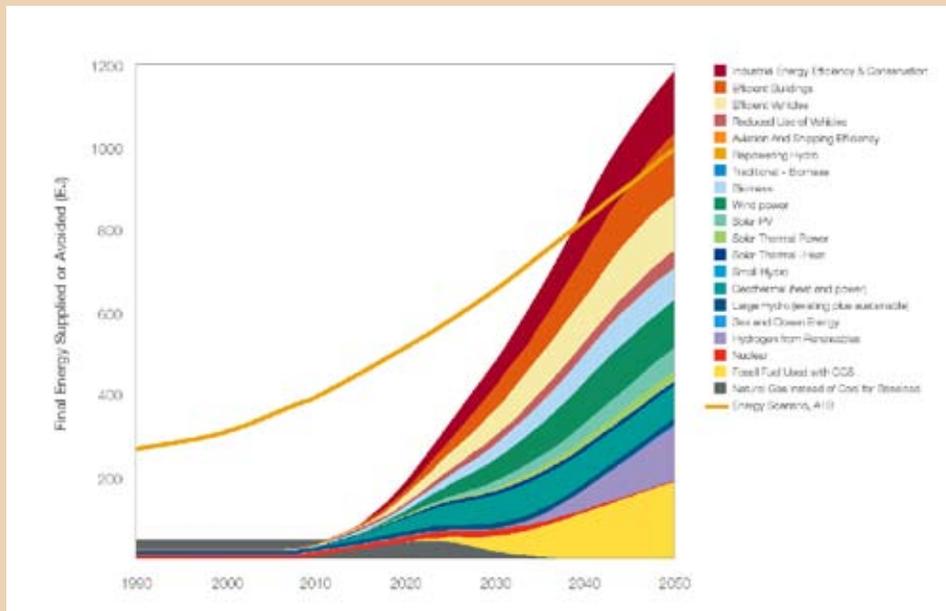


Addressing The Climate Change Challenge

In 2006, WWF convened a Global Energy Task Force (ETF) to develop an integrated vision of energy supply to 2050. The ETF explored the potential for meeting the projected global growth in demand for energy services while avoiding the most dangerous impacts of climate change by using energy sources that are socially and environmentally benign. The WWF report *Climate Solutions: WWF's Vision for 2050* concludes that a major diversification of fuel use into zero and low emissions sources will be required to avoid dangerous climate change, but that the technologies do exist and there is sufficient time for their deployment.

The report finds that the role of fossil fuels is maximised if emissions from fossil fuels are minimised. Fossil fuels used with CCS are presented as one of the climate solutions wedges with the potential of providing 26 percent of total energy supply by 2050; in this scenario, coal used with CCS can supply 20 percent. Other important climate solution wedges include:

- Increased end-use energy efficiency across all sectors;
- Halting and reversing loss and degradation of forests, particularly in the tropics;
- The rapid and parallel pursuit of the full range of renewable technologies, such as wind, hydro, solar PV and solar thermal, and bioenergy within strictly defined environmental and social constraints to ensure their sustainability;
- Developing flexible fuels, energy storage and new infrastructure;
- Displacing high-carbon coal with low-carbon gas to avoid a lock-in of coal.



MIT's 2007 report "The Future of Coal," also supports coal's continued use as an energy resource, but like the WWF, with the critical caveat that CCS must be implemented:

"We conclude that carbon dioxide capture and sequestration (CCS) is the critical enabling technology that would reduce carbon dioxide emissions significantly while also allowing coal to meet the world's pressing energy needs."

The report goes on to state that:

The priority objective with respect to coal should be the successful large-scale demonstration of the technical, economic, and environmental performance of the technologies that make up all of the major components of a large-scale integrated CCS system—capture, transportation and storage...such demonstrations are a prerequisite for broad deployment at a Gigaton scale in response to the adoption of a future carbon mitigation policy, as well as for easing the trade-off between restraining emissions from fossil fuel resource use and meeting the world's future energy needs.¹¹⁰

¹¹⁰ "The Future of Coal: Options for a Carbon-Constrained World," Massachusetts Institute of Technology, 2007.

Can Coal Be Reformed to Serve a Carbon-constrained Economy?

In order to avoid dangerous climate change, coal must be used with low emissions technology and its use must be limited at a global level in order to achieve necessary CO₂ reductions.

The following measures will help to ensure that coal is used in a way that is socially and environmentally responsible, and adequately addresses the problem of global warming:

- A global cap and trade system to regulate carbon emissions based upon the Kyoto Protocol
- A robust cap or price on carbon at a national level
- Technology and funds transfer to bridge the cost gap between conventional energy and zero and low emission sources
- A regulatory framework for CCS governing issues such as safety, verification and long-term monitoring of captured carbon dioxide
- Maximum use of energy efficiency to reduce the demand for energy generation
- A diversification into other indigenous energy sources such as renewables to reduce the overall dependency on coal.

Conclusion

Coal is abundant and affordable in the AP region, and for the foreseeable future could be used to meet the region's growing energy needs, but what becomes of those needs when air is too dirty to breathe; water is too polluted to drink; soil too contaminated to grow crops; land is unfit for habitation; and global warming unleashes unimaginable environmental disasters? Who will the industry serve when people's basic survival is threatened by the pollution it produces?

This report has sought to examine the straightforward social and environmental truths of the continued use of coal in the AP region, against the more complex reality of skyrocketing demands for energy in developing economies, and the political and bureaucratic growing pains of such needs. For coal to be a viable energy resource, governments of the AP region must look to a future that prices coal at a level which accounts for its true social and environmental cost; give the public tools to engage in discourse with the coal industry; and do more than pay lip service to the very real potential of low emissions coal technology, such as CCS, while simultaneously reducing the region's dependence on coal. Because in the absence of such action, they may find themselves saddled with budget breaking health crises, food and water shortages, social unrest, and extreme climate change impacts, in order to keep the lights on.



Annex 1

External costs of coal burning

Media of pollution	Damage caused by pollution			Economic loss (RMB/Ton)
Air	Pollutant	General area of impact	Specific area of impact	
	PM ₁₀	Health	Death	32.2
			Hospitalisation due to diseases of the respiratory and circulatory systems	1.6
			Chronic bronchitis	11
			Subtotal	44.8
	SO ₂ and acid rain	Agriculture	Rice	1.6
			Wheat	1.1
			Rapeseed	0.8
			Cotton	0.3
			Soybean	0.7
			Vegetables	21.2
			Subtotal	25.7
		Industrial and transport materials and facilities	Damage from erosion, cost of repair and accidents	2.7
	Lifespan of buildings	Cost for erosion, cleaning and replacement	4.1	
	Subtotal		12.7	
Water	Water shortage for utilization			7.2
	Unsafe drinking water			0.9
	Poor category IV industrial water supply			2.3
	Poor category V agricultural water supply			2.3
	Subtotal			12.7
Land	Soil pollution from heavy metals			1.2
	Opportunity cost of land occupation caused by disposal of solid waste from coal burning and power generation			0.5
Total				91.7 RMB/ton

External costs of coal mining

Damage		Cost per ton (RMB)
Air pollution from coal mining, gas, self-combustion of tailings	Impact on human health and wellbeing	6.1
	Loss in agricultural production	1.0
Water pollution due to coal mining causing shortage of water for human and animal use		3.7
Treatment of tailings		4.9
Heavy metal pollution of soil, lakes and rivers		1.1
Permanent loss due to damage to water resources		22.1
Leakage of water from mining causing shortage of water		0.2
Soil erosion		8.5
Loss of forest and biodiversity		5.4
		9.8
Cost of restoring vegetation and ecological reconstruction		0.2
Loss of wetland ecosystem		1.0
Loss due to land occupation for coal mining		3.4
Restoration of land damaged by coal mining		3.2
Losses to buildings		0.8
Losses due to transportation facilities		0.2
Total		71.4 RMB/ton

Social cost for coal production

Cost	Cost (RMB/ton)
Cost for maintaining production (overcome the impact of current increase on production materials)	3
Safe production facilities and worker safety equipment	14
Wage allowances for difficult and dangerous work for coal mine employees	10
Mandatory safety insurance to cover employees	5
Mandatory health insurance to cover employees	3
Compensation for utilization of resources	3.5
Invitation for bidding rights for prospecting and mining coal resources	3
Rationalise the resource tax for utilization of coal resources	2.5
Reduce value-added tax	-4.5
Resolve transportation problems (particularly railway transportation) and remove charges for the Fund for Railway Construction	-9
Fund for sustainable development	20
Guarantee Fund for Environmental Treatment and Restoration	30
Remove existing fee for treatment of environmental pollution and combine into the new Guarantee Fund (above)	-6.7
Fund for change of business – to be used for change of business and employee protection after exhaustion of mine resources	5
Reduction in transport and retail costs	-50
Total	85.5 RMB/ton

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The True Social Cost of Coal: The external cost for the exploitation and utilization of coal in China: a preliminary study
by the Energy Foundation, 2006

Public Participation and Development Case Study of India's Environmental Policy Making
by Bharath Jairaj and Sriharini Narayanan, 2006

Coal Mining and Development in Australia
by Geoff Evans, 2006.

Impacts of Coal Plants on Communities
by Romana P. de los Reyes, 2006.

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WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by:

- conserving the world's biological diversity
- ensuring that the use of renewable natural resources is sustainable
- promoting the reduction of pollution and wasteful consumption.



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