The True Cost of Coal

How people and the planet are paying the price for the world’s dirtiest fuel
Today, coal is used to produce nearly 40% of the world’s electricity. However, burning coal is one of the most harmful practices on the planet. It causes irreparable damage to the environment, people’s health and communities around the world. The coal industry isn’t paying for the damage it causes, but the world at large is. It’s this cost – the true cost of coal – that this report reveals, showing and quantifying its effects on people and the environment around the world.

Spiralling energy demand means that the use of coal is on the rise and at an alarming rate. Between 1999 and 2006, coal use around the world grew by 30%. Similar increases are predicted for the future if we do not reduce our dependence on this dirtiest of fossil fuels.

The single greatest threat facing our climate

The fact is that coal is the most polluting energy source around, and the dominant source of the world’s carbon dioxide (CO₂) emissions. Across the planet, 11 billion tonnes of CO₂ come from coal-fired power generation every year. In 2005, this made up just about 41% of all fossil fuel CO₂ emissions. If plans to build new coal-fired power plants go ahead, CO₂ emissions from coal will increase 60% by 2030.

Climate change is the greatest environmental threat and humanitarian and economic challenge the world has ever faced. Millions of people are already feeling the impacts of climate change and an estimated 150,000 people die each year from its effects. To avoid the worst impacts of climate change, including widespread drought, flooding and massive population displacement caused by rising sea levels, temperature increases must peak as far below 2°C (compared to pre-industrial levels) as possible. To do this, the Intergovernmental Panel on Climate Change (IPCC) in its Fourth Assessment Report indicates that global greenhouse gas emissions must peak at the latest by 2015.

How we deal with the coal question will make or break whether we get there. Indeed, James Hansen, the top NASA scientist, has stated that the ‘single most important action’ needed to tackle the climate crisis is to reduce CO₂ emissions from coal – an opinion repeated by experts around the world.
Why is revealing the true cost of coal important?

Coal may be the cheapest fossil fuel on the market, but its market price is only half the story. The financial price includes a range of factors, from mining and retailing costs to government taxes and, of course, profit, but it ignores some of the biggest costs of coal: the tremendous human and environmental damage it causes. If the true cost of coal to governments and people around the world were reflected in its market price, the viability of building ever more coal plants would be very different.

This damage doesn’t start and finish with the CO₂ emissions caused during coal burning. The entire process – or chain of custody – from mining, through combustion to waste disposal, and in some cases recultivation has a dire impact on the environment, human health and the social fabric of communities living near mines, plants and waste sites. It severely disrupts ecosystems and contaminates water supplies. It emits other greenhouse gases like nitrogen oxide and methane, as well as black carbon and toxic chemicals like mercury and arsenic. Leaking waste ruins fish stocks and agriculture, and therefore also livelihoods. It directly contributes to health problems like black lung disease. Because none of these are reflected in the price of coal, they’re referred to as ‘external costs’.

These external costs are inevitably paid by society – often by its poorest members. In Jharia, India, thousands of people living around the area’s decaying coal mine endure horrendous living conditions caused by uncontrollable coal fires. In Russia, unsafe mining conditions have meant injury and death for scores of workers. In the Kuyavia-Pomerania region of Poland, mining activities have caused the water level of Lake Ostrowskie to drop dramatically. This list of examples could go on indefinitely.

In purely economic terms, the continued use of coal is also a ticking time-bomb. Greenpeace’s own preliminary analysis of the true costs of coal, conducted by the Dutch Research Institute CE Delft, shows that damages attributable to the coal chain-of-custody amount to roughly €360 billion in 2007 (See True Cost of Coal, page 9). This figure is most certainly an underestimate, as it doesn’t account for all damages caused by coal. Nevertheless, it gives an idea of the scale of harm we subject ourselves and our environment to by continuing to mine and burn coal.

As more coal-fired power plants are built, external costs will increase dramatically. We’re taking vast sums – particularly when it comes to fighting global warming caused by burning coal. In 2006, the Stern Review on the Economics of Climate Change insisted that 1% of global Gross Domestic Product (GDP) each year needs to be invested to combat climate change – Stern increased the estimate to 2% in June 2008. What’s more, according to the review, costs required to tackle the effects of climate change could reach between 5% and 20% of the global GDP by 2100.

An urgent need for action

The true cost of coal underlines the urgent need for action to avoid the disastrous consequences of a coal-powered future. While most governments so far have been slow to react, community movements are forming across the globe and demanding an end to coal. These movements are strong and gaining momentum.

The good news is that a future without coal is possible: the world already has enough technically accessible renewable energy to meet current energy demands six times over. For example, the world’s wind resources alone are estimated to be more than twice the world’s projected electricity consumption in 2020. Greenpeace’s Energy Revolution blueprint shows how renewable sources of energy, combined with greater energy efficiency, can cut global CO₂ emissions from fossil fuels by 50% and deliver half the world’s energy needs by 2050. Moving to a renewable future would save the world up to US$180 billion a year in comparison to business as usual. This is the exact amount needed in extra aid to reach the Millennium Development Goals (MDGs) by their target date of 2015.

Coal powered the Industrial Revolution. Now, clean energy technologies need to take over and power a new revolution in energy to help the world escape the clutches of climate change.

‘There is now almost 40% more carbon dioxide in the atmosphere than before the Industrial Revolution. Current CO₂ levels are higher than at any point in the last 650,000 years.’*

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*See National Oceanic Atmospheric Administration Available at: www.esrl.noaa.gov/gmd/ccgg/trends.
Traditionally considered the cheapest fuel around, the market price for coal ignores some of its most significant impacts. These so-called “external costs” manifest themselves as damages such as respiratory diseases, mining accidents, acid rain, smog pollution, reduced agricultural yields and climate change.

The harm caused by mining and burning coal is not reflected in its price per tonne or what it costs for a kWh of electricity, but the world at large is nevertheless paying for it. This report seeks to answer the question: Just how much are we paying?

While it currently isn’t possible to account for all the devastation coal wreaks on a global scale, it is possible to approximate the annual damage costs for some of its more conspicuous impacts.

At the request of Greenpeace, the Dutch research institute CE Delft conducted a preliminary analysis of the external costs of impacts to human health and the environment caused by coal mining and combustion. This evaluation focused on the external costs in 2007 of damages attributable to climate change, human health impacts from air pollution and fatalities due to major mining accidents—factors for which reasonably reliable global data is currently available.

Based on the factors examined, the analysis reveals:

• Coal-fired power stations caused an estimated €356 billion worth of damage in 2007;
• Accidents in the global coal power chain cost at least €161 million in 2007; and
• Mining carries with it hidden damage costs of at least €674 million in 2007.

Combining all damages listed above, CE Delft arrived at a total global damage figure of roughly €360 billion.

This staggering number is most likely an underestimation of the yearly damages caused by coal around the world, as not all impacts were assessed while costs for climate change are expected to increase dramatically in the future. In many ways, the true cost of coal on a global scale defies calculation, largely due to the absence of data that reliably catalogues coal’s every negative effect. What’s more, quantifying many social impacts, such as community displacement, loss of cultural heritage and human rights violations in a credible manner is virtually impossible. While the figure presented above does not precisely quantify coal’s every cost, it does provide a sense of the scale of harm we subject ourselves and our environment to by continuing to mine and burn coal.

In an age of high energy prices and seemingly insatiable energy appetites, the lowest-cost energy sources tend to be the most favoured. While coal might be comparatively cheap in the marketplace, in reality the cost of coal is far too high and the world simply cannot afford to continue using it. Given the availability of alternatives such as renewable energy and energy efficiency, which can meet our energy needs in a safe and climate-friendly way, there is no need to continue relying on coal. We must reduce our dependence on this dirty fuel and abandon plans to build new coal-fired power stations. The true cost of failing to do this—and not harnessing instead the potential of a clean, sustainable energy—is something we dare not contemplate.
Climate change is the greatest environmental threat and humanitarian and economic challenge the world has ever faced. Millions of people are already feeling the impacts of sea-level rise and coastal erosion and the increasing intensity of natural disasters such as floods, droughts, severe storms and forest fires. Such effects will only get worse as temperatures rise. More frequent severe weather will also affect agriculture and further undermine food security. A warming world could also see diseases like dengue fever and malaria spreading. If nothing is done to reduce emissions of carbon dioxide (CO₂), the main global warming gas, one-quarter of plant and animal species face increased risk of extinction.²¹

In Bangladesh and India alone, the impacts of climate change such as sea-level rise and drought could force 125 million people from their homes. Up to 1.2 billion people in Asia could suffer increased water shortages by 2020, according to the United Nations climate panel. Wheat production could disappear from the African continent.²²

In contrast, a business-as-usual approach would allow CO₂ emissions from coal to rise by 60% by 2030. Those pedalling technological fixes – such as carbon capture and storage (See Carbon Capture and Storage (CCS) – the flawed case for business as usual, page 12), which claim to make coal clean and safe for the climate – create a dangerous distraction as the world seeks truly sustainable solutions that will reduce emissions and protect our climate. It is only by quitting coal and increasing energy efficiency and production of renewable energy that we will prevent catastrophic climate change.
Carbon Capture and Storage (CCS) – the flawed case for business as usual

CCS aims to reduce the climate impact of burning fossil fuels by capturing CO₂ from power plant smokestacks and dumping it underground.

Its future development has been widely promoted by the coal industry as a justification for the construction of new coal-fired power plants and ‘business as usual’. But CCS cannot deliver in time to avoid dangerous climate change – the earliest possibility for deployment of CCS at a useful scale is not expected until at least 2030, while global greenhouse gas emissions must start falling after 2015 to avoid the worst impacts of climate change.

Concerns about the feasibility, costs, safety, and liability of CCS also make it a massive gamble – one that risks taking attention and investment away from the deployment of renewable energy sources. A recent survey of 1,000 ‘climate decision-makers and influencers’ around the world revealed substantial doubt in the ability of CCS to deliver. Just 34% were confident that retrofitting ‘clean coal technology’ to existing power plants could reduce CO₂ emissions over the next 25 years without unacceptable side effects, and only 26% were confident in its ability to deliver low-carbon energy from new power plants. singled out CCS as a major flaw in the coal industry’s claims to have a credible plan to address climate change.

In short, CCS won’t be ready in time to save the climate and should not be used as an excuse to continue burning coal.

For more information about CCS, see the 2008 Greenpeace report ‘False Hope: Why carbon capture and storage won’t save the climate’ – www.greenpeace.org/ccs.
Drought in Australia has forced grazers already facing economic hardships to re-evaluate stock numbers, prompting large livestock sales throughout the country. Climate change will only make this worse. Rising temperatures will likely increase the occurrence and severity of droughts in southern and eastern Australia, exacerbating security problems. Production from agriculture & forestry is projected to decline by 2030 over much of the region as a result.

An elderly woman looks out from her balcony onto the floods in Arles, France. Climate change is projected to make extreme river floods even more frequent in some areas, especially in central, northern and northeastern Europe. From 1998-2002, Europe suffered about 100 damaging floods causing some 700 fatalities, the displacement of about half a million people, and at least 25 billion Euros in insured economic losses.

Sophit Sataporn, holding her child, stands in front of her house in Laem Talumphuk cape. Her family, house and village are being threatened by rising sea levels. A climate change-induced wind pattern has intensified the speed of coastal erosion in both the Gulf of Thailand and the Andaman Sea. On average, five meters of coastal lands in the region are lost each year.

A winter drought, caused crop losses of around 80% amongst corn farmers in the Rio Grande do Sul in 2005. Carlos Barbosa, pictured here, normally harvests 120 sacs per hectare but in 2005 he only harvested 28. The agricultural sector is extremely sensitive to climate variability. Decreases in precipitation are predicted by the end of the 21st century for the Northern and Southern Tropics. In some African countries, yields from rain-fed agriculture could be reduced by up to 50% by 2020.

Climate change is already having serious social, ecological and economical impacts. We are already close to the thresholds of irreversible change for certain parts of the climate system, such as the Arctic sea ice. Preventing dangerous climate change means halting the growth in CO₂ emissions by 2015 and then more than halving CO₂ output by 2050. The inescapable conclusion is that we have to phase out use of coal.
The Chain of Custody

Coal’s journey from the ground to the waste heap is often called its chain of custody. The chain has three main links – mining coal, burning coal and disposing of coal’s waste. When you look at the facts, one thing very quickly becomes obvious: each part of the chain causes immeasurable damage to our planet and the health of the people on it. In the next section, Coal first hand, we share the stories of people who are feeling these effects of coal today.

Mining coal

Mining causes widespread deforestation, soil erosion, water shortages and pollution, smouldering coal fires and the emission of greenhouse gases. Massive excavation operations strip land bare, lower water tables, generate huge waste mountains and blanket surrounding communities with dust particles and debris. Mining leads to the loss of fertile soils through erosion while runoff into nearby water bodies clogs rivers and smothers aquatic life. It kills miners quickly through accidents or more slowly with black lung disease. And it also displaces whole communities, forced to abandon their homes because of coal mines, coal fires, landslides and contaminated water supplies.

Burning coal

Coal combustion leaves a similar trail of destruction in its wake. The huge volumes of water needed to “wash” coal and cool operating power stations cause water shortages in many areas. Pollutants spewed from smokestacks threaten public health and the environment: fine dust particles are a major cause of pulmonary (lung) disease; mercury harms neurological development in children and the unborn; and coal-fired power plants are the biggest single source of polluting emissions, such as carbon dioxide, sulphur dioxide, nitrogen oxides and methane contributing to climate change and causing acid rain and smog.

Coal’s legacy

The damage caused by coal doesn’t end once it’s burnt. At the end of the chain are coal combustion wastes (known collectively as CCW), abandoned mines, devastated communities and ravaged landscapes. CCWs are toxic and often laced with lead, arsenic and cadmium that can cause poisoning, kidney diseases and cancer respectively. Acid mine drainage (AMD) damages soils and makes water unsafe for consumption. Collapsing mines cause land to subside, resulting in structural damage to homes and buildings and infrastructure like highways, buildings and bridges. Attempts to mitigate the devastation left once coal is removed are inadequate at best. “Reclaimed” land never quite recovers; poisoned communities remain contaminated; and no matter how hard you scrub, the social fabric of human societies is forever dirtied with coal dust.

Every link in the chain of custody contributes to the overall damage caused by coal – each in its own particular way. This damage is real. It will only get worse in the future if nothing is done. And it all forms part of the true cost of coal.
How do you calculate every single instance of environmental damage? How do you quantify human rights abuses suffered by workers in the coal industry? How can you put a price on communities seeing their culture eroded?

The following stories come from those directly affected by coal, right now, shedding light on these unquantifiable issues. They all come from countries particularly afflicted by coal, showing its effects at each stage of its lifecycle: from mining to combustion and coal’s dirty legacy.

In Columbia, indigenous communities are threatened and forced off their lands to make way for coal mines; thousands in Jharia, India suffer from horrendous living conditions because of uncontrollable coal fires; in Russia, unsafe mining conditions have meant injury and death for scores of workers.

When calculating the true cost of coal, we can assess much of the damage, like the cost of health care, harm caused by climate change, and mining accidents in financial terms. But it’s impossible to put a cost on everything.

In places like Indonesia, China and Thailand air pollution from coal combustion is destroying livelihoods, damaging ancient relics, reducing crop yields and killing people. The legacy of mining ensures that land in South Africa will continue to be poisoned by acid mine drainage long after mines are closed while in the Kuyava-Pomerania region of Poland, mining activities have caused the water level of Lake Ostrowskie to drop dramatically. In the United States coal has meant blowing up mountains, burying streams and contaminating nearby communities. In Germany, reclaiming opencast mines has created dead lakes with water as acrid as vinegar.

However, in response to the unmitigated destruction and harm caused by coal, communities are rising up. In Australia, winemakers, horsebreeders, local residents and miners are saying no to mine expansion and yes to a just transition to renewable energy. In the Philippines, a diverse group has united to oppose a new coal-fired power station, calling instead for clean energy development. Stories such as these inspire, provide hope and point the direction towards a better future – one not marrned by dirty coal but fuelled by energy sources that are safe, sustainable and will protect our climate.
Colombia is the fourth largest coal exporting country in the world. The Cerrejón Zona Norte (CZN) mine on the Guajira peninsula is the largest opencast coal mine in the world. The site is also infamous for widespread human rights violations against indigenous and Afro-Colombian people.
CZN was run as a joint venture between ExxonMobil and the Colombian government from the 1980s until 2001, when it was taken over by a consortium of European-based mining companies including BP, Billiton, Glencore, and Anglo-American.\(^{26}\) Covering 150 square miles in southern Guajira, the site consists of an integrated mine, railroad, and coastal export terminal.\(^{27}\) While it currently produces about 30 million tonnes of coal per year, the mining company is investing US$1 billion to increase production to 40 million tonnes per year by 2011.\(^{28}\) The Colombian government claims that the mine brings progress to the poverty-stricken region of La Guajira. But the reality is that Afro-Colombian and indigenous communities are under siege by the mine (See Violated). Much of the land close to the mine is uninhabitable due to blasting, dust and contamination. Miners and local communities suffer from poor health and the loss of land, homes, livelihoods and even life. The surrounding air is polluted by fly ash and methane, and the water is contaminated by waste sludge and a cocktail of other chemicals.\(^{29}\)

The effects of CZN first hand

False promises

The Wayuu indigenous people from Tamaquito are some of the worst affected by the mine. Initially, they were promised something very different: “On arrival, the mining company offered the Wayuu participation in the benefits of the coal mining. This implied ‘development’ and ‘progress’, which for the Wayuu meant a solution to the problems of poor water supplies, education, and health care,” said Remedios Fajardo Gómez.\(^{30}\) The contamination arrived as mining operations advanced. Coal dust and noise from the equipment and the explosions have affected human, animal and plant life in the communities near the mine. Several Wayuu died and others were permanently injured by poisoning, after eating contaminated garbage from the mining company’s dumps.\(^{31}\) Jairo Dionisio Fuentes Epiayu, the governor of Tamaquito, told us what happened next:

“As time passed, the relationship with the mining companies went from bad to worse, and we started to see the bad implications of the [mining] proposal... the companies continuously violate our rights, they do not respect our traditional laws that must be applied to compensate the irreversible damage they have caused to the communities and its natural resources.”\(^{32}\)

Today, Tamaquito is isolated, without employment, and without access to schooling, health services and transport links. The villagers’ livelihoods are threatened, as they are left without any means of subsistence. “We realised we had made a mistake,” Jairo said. “The mine has completely surrounded us. We do not have access to roads to leave our village, our children cannot access schools, we have to walk on trails, and it takes us four hours to go to the nearest village... CZN does not even allow us on its property to hunt, and our hunting grounds are depleted because of the mine. We need to support ourselves by hunting, by planting, but now Cerrejón has bought all the land, so we have no chance of surviving.”\(^{33}\)

Forced displacement and isolation

In 1980, the community Media Luna was chosen as the spot to construct the port needed to ship coal from CZN around the world.\(^{34}\) Next to the port, the mining company also built an airport, a train terminal and a complete industry complex.

At the time, 750 Wayuu lived at Media Luna. Initially, the company and residents of Media Luna started negotiations towards a resettlement programme. However, community members were threatened and shouted at by company representatives in the process and the negotiations eventually broke down.

The Wayuu were forced to relocate to an area nearby, but it didn’t take long for their new home to become heavily contaminated with air and water pollution from the mine. The company ordered the Wayuu to move again, but 42 people from seven families refused to leave. The mining company’s response? They put a chain-linked fence around the families living there. They put locks on the gate to the fence and armed guards patrolled the area to report the movements of the residents. The residents were also harassed, prevented from building new houses, and even denied access to water. Still they stayed, and they continue to do so today.

Demolition and destitution

The Wayuu are not the only community to have been displaced by force. A number of Afro-Colombian communities were dispersed without compensation when the mine was first being developed.

One of these was Tabaco, which was wiped off the map in 2002 to allow for the expansion of the Cerrejón mine. On that occasion, employees of the mine, armed security guards and even the army, forced residents to leave under threat. Some were even literally dragged out from their homes before the village was levelled with bulldozers.\(^{35}\) Today, Tabaco lies buried in the middle of the coal mine. Its residents have been scattered, with about 60 families still living in inadequate provisional dwellings in the coal town Albara.

Emilio Pérez, a former resident of Tabaco, spoke of life there before the mine. “Life was rich. We shared, and no one suffered because we shared what we had,” he explained. “There was a river near the town. We had land. We walked freely all over the territory. But the last nine years we have had no land to work. We are displaced, and we have no lodging.”\(^{36}\) Under Colombian law, indigenous and Afro-Colombian communities can claim collective land titles that they identify as ancestral lands. However, although the Tabaco community has farmed their lands for centuries, they cannot pursue legal titles because the land quite literally isn’t there anymore; it has been swallowed up by the mine and completely destroyed.\(^{37}\)

Illegal negotiation tactics

Another community threatened with the same fate as Tabaco is Chancleta. Here, the mine company has been putting pressure on the inhabitants in a new and sinister way, using “divide and rule” tactics to weaken and ultimately break up local communities. Chancleta residents were intimidated if they sought collective negotiation, they were told that they must agree to individual settlements – or get nothing. The president of the Chancleta neighbourhood council, Wilman Palmezano explains more:

“From the beginning, the mining companies chose to negotiate with the villagers on an individual basis to assess compensation for land and houses. However, most communities want to conduct collective negotiations to obtain a new area to rebuild their village with houses, land and an infrastructure of roads, schools, and churches.”\(^{38}\)

The company is now negotiating collectively with Chancleta. In the past they refused to, but now the company has changed tactics, partly as a result of intensified pressure towards the company, internationally and nationally.

The outlook

Forced displacement of hundreds of families from their homes and lands, destruction of collective and family relations, damage to health, death of flora and fauna – no mining company can justify so many violations.

What makes the situation even more tragic is that the residents of Chancleta, Media Luna and Tabaco did not realise the coming of the mine would mean the end of their community. By the time they did, it was too late. It’s likely that they won’t be the last communities to fall to the same fate.

Story By: Erika Bjureby

Violated

The claims of coal’s benefits to the world – such as cheap electricity and employment – do not seem to include the people that actually reside in mining regions. Mining operations regularly displace whole communities and can force people off land because of coal fires, subsidence, contaminated water supplies, air pollution and other impacts.

The Colombian case study clearly shows the dire impact of coal mining on communities living next to mines. The villagers in this story were seeking only to exercise their human rights, and instead found themselves fighting to defend their lives and their land.

If this is not enough, the struggle of the workers against conditions in the mines has resulted in the murder of four trade unionists in Colombia. Four leaders of the Sintamienergética miners union, who worked for the Drummond mine – a US-based coal company in northern Colombia, were murdered in 2001 by right-wing paramilitary forces near the firm’s La Loma operation. The case was brought to court in USA to expose Drummond’s involvement with the paramilitary and violence against workers in Colombia. However, in the end, Drummond was found “not liable” in the deaths of the trade unionists. This ruling, of course, further worsened conditions for the workers and exacerbated the conflict between the union and the company. This is just one example of how the coal’s impact on human rights – and elsewhere in the world, women’s day by day.
India

A living pyre

The largest coal belt in India at Jharia, Jharkhand. Before coal mining commenced here, Jharia was a belt of dense forests inhabited by tribes.

Early morning at Bokahapadi Village at the other side of the valley from the Rajapur Mining Project. The ignited coal burning underneath the village causes the release of toxic fumes. The town is slowly cooking underneath its surface.

Security from the Central Industrial Security Force in Rajapur Mining Project guard against the illegal miners. A guard explains: ‘After my posting in nice places like Shillong and Sikkin, this place seems like hell on Earth.’

Illegal coal pickers cautiously collect coal during the day while keeping one eye on the security forces that patrol the area.

An illegal coal picker stabs at the ground in search of coal under the surface. The coal she collects will be sold at the local market to pay for her food.

Collecting coal is a family effort – every able body is expected to help. As a result, many children form a part of the illegal coal picking workforce.

Jharia is one of the most important coal mines in India and one of the largest in Asia. Once a treasure trove of high-quality coking coal, uncontrollable coal fires have turned the mine into an incessant inferno.

Case Study: Mining

Greenpeace International

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Section Three

India

A living pyre
A loading truck at the Rajapur Mining Project. Smoke and noxious fumes from the underground coal fires escape into the atmosphere. Smoke from the fires contains poisonous gases including carbon monoxide, carbon dioxide, sulphur dioxide and nitrogen oxide.

Coal miners lift coal upon their heads from dawn till dusk in sweltering temperatures. It’s a miserable existence but few other options are available to make a living.

A child plays with his kite amongst the toxic fumes and burning ground caused by the underground coal fires around Bokahapadi Village in Jharia.

‘India accounts for the world’s greatest concentration of coal fires. Rising surface temperatures, and toxic by-products in groundwater, soil and air have turned the densely populated Raniganj, Singareni and Jharia coal fields into wastelands.’

Crumbling under fire and subsidence, Jharia is a place of smouldering land and noxious fumes that make breathing difficult. Yet thousands of inhabitants cling to this collapsing town, eking out a living. Many of them are illegal coal collectors, who spend their days frantically picking up pieces of coal from the mine dump to sell at the local market for 50 Rupees (US$1.20) a basket.

It’s a miserable existence. To make matters worse, the threat of displacement hovers over their heads on a daily basis as the fires continue to spread (See Burning Just Below the Surface).

How did it come to this?

Before coal was unearthed in this area, Jharia was a belt of dense forests inhabited by tribes. Agriculture and cattle rearing were the basic forms of livelihood. Lore has it that king Raja Shiv Prasad Singh, who reigned over Jharia and surrounding areas, first leased 200 acres of land to a Gujarati merchant for just Rs200 (US$5) to mine coal seams and waste heaps set alight by neglect and land use. The fire spread, almost nothing was done to extinguish it. “The company started opencast and slaughter mining because it is cheaper and can be easily done. Once the fire spread, almost nothing was done to extinguish it. Sand stowing is avoided because it is expensive. Fire zones are left open. Now they want to remove all the people and extract more coal. However, their compensation is useless compared to the damage done. What will people do where there are no jobs?”

As Jharia burns, people continue to put up with the horrendous conditions, the disease, pollution and threat of displacement. Why? Because they have no other choice.

Story by: Jayashree Nandi

Displacement

In spite of all these issues, what people worry about most is displacement. Technical director of BCCL, T.K. Lahiri, recently announced, “Loss of good quality coking coal is a national loss. It is in a way degradation of environment. BCCL is losing its profitability and people are living in extremely unsafe conditions. The only solution is to rehabilitate people inhabiting in such hazardous areas.”

This rehabilitation comes in the form of the Jharia Action Plan – a Rs 60 billion (US$1.5 billion) initiative to re-house inhabitants and get the coal fires under control. In response to the plan, India’s Ministry of Coal has also released Rs 600 million (US$15 million) for a pilot project to build housing for the residents of Bokapahari, one of the worst affected areas.

These plans are good in principle but they don’t address the complexity of the problem. In fact, in Bokapahari there is widespread and strong resistance to the forthcoming displacement. According to the residents, huge families of eight to ten people are being given one-room structures. Belagaria (where the new housing is being built) is far away from the city, and has hardly any employment opportunities. Given the gloomy choice of living in fire zones or losing their livelihood, most people have no choice but to try to stay put.

Ashok Agarwal, president of Jharia Bachao Sangharsh Samiti – a local resistance body currently fighting BCCL’s plans in the Supreme Court – sums up the no-win situation as follows: “The company started opencast and slaughter mining because it is cheaper and can be easily done. Once the fire spread, almost nothing was done to extinguish it. Sand stowing is avoided because it is expensive. Fire zones are left open. Now they want to remove all the people and extract more coal. However, their compensation is useless compared to the damage done. What will people do where there are no jobs?”

As Jharia burns, people continue to put up with the horrendous conditions, the disease, pollution and threat of displacement. Why? Because they have no other choice.
Russia

The human cost of coal

Striking mine workers blockade the Vorkuta-Moscow railway, permitting only passenger trains and cargo trains of liquid fuel to go by. Unrest amongst these workers is the result of poor working conditions and owed wages.

A group of miners at the Komsomolskaya coal mine in Vorkuta. A career in Russian mines means many of these men will suffer from chronic injuries and severe illnesses.

Mining is perhaps the most dangerous profession in Russia. Tragic mining accidents are not uncommon. This miner survived a methane blast that killed several people at the Komsomolskaya mine.

The Russian coal industry employs 200,000 people, producing 309 million tonnes of coal in 2006. Mining is perhaps the most dangerous profession in the country. But official statistics on mining accidents and health impacts are not easy to come by.

This miner suffered grave burns when a methane explosion ripped through the Vorkutinskaya coal mine in northern Russia. Five miners died in this blast and 12 others were badly injured.

Vorkuta miners protesting against wage arrears managed to close down the biggest mine in Russia, Vorgashorskaya, for a period of two months.

The workers want their wage arrears for many months to be paid in full. Nowadays they have no money to buy even the most necessary things as food and medicines. Their families live in horrible ramshackle houses, the former barracks used for living of the prisoners' escort servicemen 50 years ago.

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How people and the planet are paying the price for the world’s dirtiest fuel
Russian coal mines are hazardous and chronically underfunded. As a result, accidents are frequent and the human cost is shockingly large. In 2000, a mine blast in Kemerovo in southern Siberia killed 13 people. The following April, 45 more miners were killed in an explosion in the same region. One year later, in 2001, a methane explosion claimed the lives of another 21.24 Two years later, Russia suffered its worst mining disaster in more than 60 years when 110 coal miners perished in a blast at the Ulyanovskaya mine. This tragic accident was shortly followed by another in which 38 more miners died.25

A national report commissioned in 2006 found that the Komi Republic (one of the leaders in coal production) had an overall occupational disease rate of 8.3 per 10,000 employees – five times the national average. These figures make the coal industry the most dangerous profession in Russia, with 26.5 work-related diseases for every 10,000 employees.26 While these numbers are big enough to raise alarm, they do not reflect the whole picture of coal mining in Russia, where thousands of workers suffer from chronic and severe illnesses (See Health Risk).

Vorkuta – a town ruled by coal

Located 160 km inside the Arctic Circle, Vorkuta is a mining city with a population of more than 100,000. It was originally built in the early 20th century, and has grown with the success of its coal industry. However, recent mine closures and the health problems that result from a career in the mines means that few in the town have been left untouched by mining’s negative effects.

Health issues

Today, five mines in Vorkuta employ about eight thousand people. Out of 114 cases of occupational disease reported in the town in 2007, 101 were in the coal mines.27 The most common illnesses are the chronic diseases associated with industrial equipment, physical overwork, strained organs and systems. In 2008, there were also around 30 cases of chronic bronchitis, 10 cases of cochlear neuritis, 5 cases of dust disease, 2 cases of pneumatic hammer disease and 2 cases of lung cancer.28

The impact of Russian mining first hand

One miner who has suffered greatly for his work is Ainiyatulla Tukhfatullin. He was born in 1949 in a village in Tatarstan, a province in the Volga basin. In 1971, after service in the army, he came to Vorkuta and was employed in the Zapolyarnaya mine. For 34 years, he worked with primitive tools in mines between 250 to 750 metres underground – breeding grounds for disease and illness.

Injuries

Injuries were part of his life: “At the beginning of the 70s, we didn’t even have rock-drills. We mined coal with saws, axes, shovels. There were also electric drills: they said they weighed 32 kg. I have fractures head-to-toe. If I start telling you my medical history, your notebook won’t be long enough to write it all down.”29

He spoke about one incident in 1987 when he was hit by a falling rock. It left him hospitalised and in agony for two months with a fractured clavicle. In 2004, Ainiyatulla was diagnosed with pneumatic hammer disease: “You see, my hands are shaking – that’s pneumatic hammer disease,” he explains.30

In 2005, Ainiyatulla was injured in an underground accident. He fell, causing a knee ligament to rupture on his left leg. He needed a serious and painful operation – with a seven-month stay in a hospital bed. It ended his career and he now gets invalidity benefit. It comes to about 7,500 roubles a month, plus compensation of about 10,000 roubles. That’s only about US$700 a month, hardly enough to live on.

A lack of care

Today, Ainiyatulla spends lots of his life at the centre of occupational pathology, making the journey there for treatment courses five times per year. Each course lasts about three weeks. He tells us: “Sometimes I also have to go by taxi. But it is very expensive, 300 roubles one way.”31

To make matters worse, a lack of public funding has forced the centre of pathology to cut back on services so people like Ainiyatulla can no longer stay there overnight. The source of funding problem is Vorkuta’s chronic deficit, which is caused in part by the fact that tax revenues from the Vorkutaugol coal company are sent to Moscow, not Vorkuta. Things are so bad in the city that there’s even talk of closing the centre altogether.

“As soon as we heard about that in April, we just couldn’t believe our ears. This is a mining city, and there will be no place where the miners’ illnesses are treated,” he added. “Write about that. Maybe then we’ll be helped to restore the day and night clinic.”32

Story written by: Ernest Mezak

Health Risk

Removing coal from the ground can be arduous, dirty and dangerous. Accidental explosions and sudden mine collapses are only a few of the many perils facing the world’s coal miners. This high risk profession also comes with long working hours under strenuous conditions. It carries with it many health hazards from exposure to noxious fumes, toxic metals and dust particles.

Black lung disease, also known as pneumoconiosis or CWP, is perhaps the most infamous health impact resulting from a career in the coal mines. It has been associated with coal mining for centuries. CWP is caused by repeated exposure to dust containing crystalline silica, which settles in the lungs causing them to harden. This in turn reduces the efficiency with which inhaled oxygen is transferred to the bloodstream. The severity of the disease varies, but it is chronic, progressive and often fatal. Although some symptoms can be alleviated, there is no known cure. Individuals with CWP suffer from shortness of breath, tiredness, emphysema and coughs, heart problems and ultimately respiratory failure.33

Black lung takes a much heavier toll on miners in developing countries. In China, about 400,000 coal miners suffer from the disease – a number that is going up by about 70,000 each year.34 In the US, the prevalence of the disease has fallen since federal mining legislation was passed but 1,400 people still die from the disease every year.35
In 2006, the bustling industrial town of Cilacap was filled with optimism. President Susilo Bambang Yudhoyono had announced the opening of a new coal-fired power plant in the area. But despite the initial hope for local economic growth, the real costs to the Southeast Java town soon became shockingly clear.

The Cilacap coal-fired power plant commenced operation in May 2006, with 2 units of 600 MW. The plant is located very close to several villages. The incessant humming and dust pollution from the power plant has driven dozens of residents in the Griya Kencana Permai housing away from their homes.

Local children play outside their homes while the cooling tower of the power station looms in the background. These children have one thing in common: persistent coughing, which could very well be due to the air pollution from the plant.

Jono is a 50-year old fisherman who catches fish in the waters around the coal plant. Since the plant started operating, he has seen his fishing catch decreased by 50%.

Diagnosed with Chronic Obstructive Pulmonary Disease, 48-year-old Munjiah spends her days in her home. She cannot afford to work in her field anymore because she is too weak. A huge number of villagers in vicinity of the power plant suffer from respiratory-related diseases.

The Cilacap power station is located in a coastal community situated in central java. Here almost 80% of the local community makes a living from fishing. However, the power station has severely impacted the waters from which these people fish and many have seen their livelihoods lost.
The original aim of building the power plant was to encourage local economic growth. In turn, this would help expand Cilacap’s industrial area to around 2,000 hectares—more than ten times its former size. At the beginning of the project, the government watched proudly. The plant was delivering 600 megawatts of electricity to the Java-Bali electricity grid. Many new jobs had been created, including a booming trade in building materials. Other locals earned money by renting their houses to construction engineers. Soon the reality hit home—and it all started with a black cloud of dust that covered the local town.

The effects of the Cilacap power plant first hand

Health

Alia is four and lives with her parents and two older siblings. An abandoned rice field is the only thing separating their home from the coal-fired power plant, 300 metres away. In the early days of the power plant being open, Alia played happily with her friends outside her house. The only small sign of danger was the persistent coughing that all the children began to pick up. It was an early sign of something far more serious: seven months ago, Alia was diagnosed with bronchitis. Her father has been affected, too. He worked at the plant for over a year, unloading the coal trucks without a breathing mask, inhaling the soot and fumes. Now he has lung spots.

Another local girl who suffers is three-year-old Safira. She’s small for her age and has had coughs and colds at least twice a month since she was born. Her mother, Rohimah, can’t afford to take her to the doctor. The only medication Safira gets is over-the-counter fever tablets and cough syrup.

Purwanto, a local doctor, tells us: “A lack of nutrition caused many of the mothers in the area to be unable to nurse their children, reducing their babies’ resistance to infections. I saw a shift to more cases of respiratory infections in children from adults in the area since the plant started operating.”

Air pollution

Unlike Purwanto, Imam Sarjono, a 59-year-old pensioner, chose to stay in his home. He worked hard to buy it for his retirement, after a long career as a warden in a high security prison. When he bought it, he was one of 200 buyers in the complex, all attracted by the prime location, fresh air, and distance from the hustle and bustle of the city centre.

Now, black soot covers Sarjono’s white orchids and the jasmine he planted in front of his house. Trees around the area have layers of black dust on their leaves. Dozens of people have been driven away by the coal dust and constant humming coming from the plant.

“We pay double our water bill to clean our houses. Dust keeps us sweeping the floors many times a day,” Sarjono tells us. “Many of my neighbours have moved away. Who can stand living like this?”

Job losses

The pollution from the plant has had a devastating effect on the ability of many to make a living from the land. About 12 hectares of productive rice fields in two villages were effectively ruined after the plant fumigated them with a mixture of hot water, effluent from the plant and salt water. This incident forced one farmer, Noto, and his son off their land. Now, to earn money, they dig sand and transport it back to his village in a small boat. With a 10-hour day starting at 6am, it’s backbreaking work just to fill a small truck. Noto’s tiny earnings are never more than about 80,000 rupiah a day, about US$8.17

Along with many of his neighbours, losing his rice field meant Noto had no choice. In fact, Noto and his son are among the lucky ones—many of his neighbours have no work at all.

A local uprising

The illnesses, pollution and deterioration in quality of life have taken their toll on the locals living near the power station. One day at dawn, in late 2005, the neighbourhood was shaken by a loud noise from the plant. Residents said it sounded like a plane taking off nearby.

“The noise kept coming on and off every five minutes. We couldn’t even hear ourselves talking. Later we found out it was the plant clearing their pipes,” said Sugriyatno, who also lives in the complex.

The incident triggered the people of the housing complex, and three surrounding villages, to gather together and protest the many problems caused by the plant. They formed a committee so they could take their complaints to the local government and the power plant.

Sugriyatno, who led the effort, said: “We are negotiating compensation for the damage in the three villages and Griya Kencana Permai complex caused by the plant’s operation. There has been a lot of damage already. However, we are still hopeful that a positive solution will come out of this.”

He also pointed out that the power plant’s owners had never showed sympathy or offered support to the local government and the police.

Story by: Nabiha Shahab

Burning up Borneo—deforestation and coal

The deforestation impacts from coal mining are readily apparent in Indonesia, the world’s second largest coal exporter. Coal extracted from Indonesian mines is shipped all over the planet to countries such as Japan and Italy. Kalimantan is the centre of Indonesia’s coal mining sector, with an estimated 21 billion tonnes of coal reserves. Of the 76 million tonnes of coal produced by Indonesia in 2000, 85% come from Kalimantan.

In East Kalimantan, mining companies have been land grabbing and securing deals for coal concessions, now millions of hectares overlap with areas of remaining rainforests. Deforestation maps for the period 2000-2007 shows recent clearance inside active mining concessions, indicating that strip mining activities are expanding. 70

One forecast by the Japanese Institute of Energy Economics estimates that Kalimantan’s production could triple by 2020. If this expansion happens, the coal industry will become one of the leading causes of deforestation in Borneo.
Shanxi Province, located in the heart of China, is the country’s great coal producer, with about a third of the nation’s coal reserves. Every day, an endless stream of trucks flows out of the region carrying their loads of the ‘black gold’ that keeps Chinese factories, the heart of the economy, up and running. This reliance on coal is not without its consequences, however. A journey through Shanxi Province reveals the trail of destruction that coal has left in its wake.

Journey through Shanxi

Mentougou district, Beijing City, China. Coal is moved from coal mines in the North and the West to power the booming mega cities in the South and the East. This creates a huge stress on the transportation system and causes serious environmental pollution along the routes.

Crumbling away – a Buddhist statue covered by coal dust in the Yungang Grottoes, Datong city, Shanxi Province, China. Despite restoration efforts, the carvings crumble away at the lightest touch.

A herder with his sheep near a coal power plant at the border between Shanxi and Inner Mongolia. Shanxi Province is the country’s great coal producer with about a third of the nation’s coal reserves.

Plant life along coal transport roads are choked with dust. It is estimated that 60 million tons of coal dust are lost from trucks and deposited along roadsides each year.

A bleak future – Xiaoyi’s dependency on coal has resulted in huge problems: a homogenous industry structure, declining employment, severe pollution, and endless disputes caused by careless and unbridled economic growth.

The coal mine, coking factory and power plant in Hanjiashan village have had a major impact on the surrounding environment and village life. Over the years, the water-intensive operations dried up the local river and wells; that and heavy pollution have lowered crop yields significantly.

Journey through Shanxi

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A city transformed – in the 1980s, Linfen in Shanxi Province was known as the “City of Flowers and Fruit” because of its plentiful fruit trees. Today it is infamous for its dirty air. In 2003, Linfen topped the national list of most polluted cities.

This coking factory is the worst kind of neighbour. The factory makes noise day and night while smoke and pollution choke residents and kill crops.

Massive coal deposits have brought economic prosperity to China. But relying so heavily on coal is not without its consequences.

“China is a big energy producer and consumer, and most of our energy is derived from coal. China must take on the responsibility to reduce pollution and emissions.”*

Datong – “The Coal Capital”

History on the brink of destruction

Datong, in northern Shanxi Province, is a city that both benefits and suffers from coal. Massive, high-quality coal deposits have brought economic prosperity to the area but at the same time are leading to its decline. Large-scale, intense exploitation means that the once-abundant coal reserves are now on the verge of exhaustion; subsequently, unemployment is rising. Coal also threatens the survival of the area’s cultural heritage. Air pollution from coal combustion is causing damage to a nearby ancient landmark and UNESCO world heritage site, the Yungang Grottoes (See Particularly Polluting).

The Yungang Grottoes are an archaeological site dating back more than 1,500 years. The Buddhist stone carvings, and cave art preserved here are priceless. Up until 1998, back more than 1,500 years. The Buddhist stone carvings and people often ask why the Institute does not use the gentlest cleaning methods, it would have an effect on the Grottoes. All we can do now is try to think of ways to strengthen and lengthen the life of these cultural relics without affecting them negatively.
Secluded in the mountains of northern Thailand lies Southeast Asia’s largest lignite coal-fired power plant, which is fed by the country’s largest open-cast mine next door. The plant has 13 generating units, a capacity of 2,625 MW, and a track record of pollution and death stretching back to the day it was first switched on.

**Thailand**

**The human price of sulphur dioxide**

Mae Moh coal plant started operation in 1978 with one unit of 75 MW and reached 13 units of 2,625 MW in 1996. This power station pumps over 7 million tons of carbon dioxide into the atmosphere each year.

Sulphur dioxide pollution from Mae Moh coal plant burns plants and reduces yield crops. This local farmer has witnessed a decline in her pineapple plantation and crop production over the years.

Close up of the leaves of a lychee tree damaged by the effects of acid rain, caused by emissions from the nearby Mae Moh power plant.

DIagnosed with Chronic Obstructive Pulmonary Disease, Khun Duong Panyaraew spends his days in a hospital bed in Mae Moh, Lampang district, Thailand. An abnormal number of villagers in vicinity of the power plant are dying of respiratory related illnesses.

Victims of power plant pollution are treated at a hospital in the Mae Moh District. Scores of people continue to suffer from major respiratory complications, and most villagers continue to be unable to afford medical treatment.

Worker pointing to a read out panel in the Mae Moh power plants. He claims that air pollution from the power station is no longer a problem.
A lethal start

On 3 October 1992, the Electricity Generating Authority of Thailand (EGAT) switched on the first 11 units at Mae Moh without any sulphur dioxide control equipment. Immediately, SO$_2$ generated by the plant started to float above Mae Moh, mixing with air and water to create a highly toxic acid rain. The rainwater contained sulphate concentrations up to 14 times higher than those typically found in uncontaminated soil. In 2003, the State Natural Resources and Environmental Policy and Planning Office found critically high levels of toxic heavy metals in almost all water sources around the plant and coal mine.

Within days, more than a thousand people from 40 different villages within seven kilometres of the plant fell ill. Exposure to the sulphur dioxide gas caused breathing difficulties, nausea, dizziness and inflammation of eyes and nasal cavities. Within two months, more than 50% of the rice fields near the plant were also damaged by acid rain. Domestic livestock started dying. At least 42,000 local people were found to be suffering from breathing problems. After this disastrous start, the plant installed some desulphurisation devices. EGAT continued to operate the plant while some of the devices were out of service or shut down for maintenance. As a result, pollution problems recurred in 1996, resulting in the death of six villagers in the Mae Moh valley from blood poisoning.

Disaster struck again in 1998, when severe SO$_2$ pollution was trapped in the valley. The toxic clouds destroyed plants and crop yields overnight, leaving hundreds sick. Out of the more than 8,200 patients visiting inspection clinics organised by EGAT in the first six months of that year, almost 3,500 were suffering from respiratory illnesses.

Any improvements?

The owners of the power plant claim to have cleaned up their act. When questioned on the issue, company engineer Khun Prasert Kipsuananatra, just smiles when asked to comment on the link between health issues and the nearby power plant. “You may take pictures in the wards if you like,” she said, “but I am not authorised to talk about this issue.”

Estimates suggest that some 300 villagers have lost their lives as a direct result of pollution from the plant, and thousands more suffer from respiratory problems. A scientific study published in 2000 concluded that, even with sulphur control equipment installed, people living near Mae Moh are three times more likely to suffer from chronic coughing. To date, over 30,000 people have also been displaced from their homes. Those that continue to live in the area face the effect of acid rain on their farmland.

Concentrations spewed out seven tons of SO$_2$ every hour. A study conducted by Greenpeace Research Laboratories in 2002 also showed that the Mae Moh power plant produces 4 million tonnes of fly ash and 39 tonnes of mercury every year. Fly ash samples taken from the power plant site contained arsenic and mercury levels that contained arsenic and mercury.

Hazy Horizons

Coal-fired power plants are major sources of sulphur dioxide and nitrogen oxides, which cause acid rain and ground-level ozone (smog). Acid rain occurs when these gases react in the atmosphere with water, oxygen, and other chemicals to form sulphuric acid and nitric acid. Smog forms when nitrogen oxides react with the chemicals in the air or sunlight. Similarly to soot, smog causes serious damage to the environment – it can destroy whole ecosystems by harming plants and trees, making them vulnerable to disease and extreme weather. Further, it can cause a wide range of symptoms to people, such as increased risk of asthma, lung damage and premature deaths.

The environmental impacts of acid rain have been well documented – largely because of the shocking visible damage it has done to so many forests around the world, particularly in Scandinavia.

Pollution control devices, such as flue gas scrubbers, have been developed to reduce these pollutants from coming out of the smokestacks. However, the fact remains that coal is still by far the single biggest source of sulphur emissions caused by power generation. In 2004, 95% of the 10.5 million tons of SO$_2$, and 90% of 2.9 million tons of NO released by US power plants came from coal. The cost of the harm caused by acid rain, smog and the other effects of these gases is huge, and makes a big contribution to the true cost of coal.

The outlook

Over the years, communities around the Mae Moh power plant have filed several lawsuits against EGAT, claiming damage for health deterioration, physical and mental grievances, compensation for medical expenses, and for damage to farmers’ crops and land. In May 2004, the Thai Provincial court awarded 5.7 million Baht (US$142,500) to the villagers for crop damage caused by the sulphur emissions from the power plant. This was a pretty small victory considering the scores of people affected, many of whom just can’t afford medical treatment. The villagers won a more substantial victory in 2006, when the energy minister promised the area 300 million Baht (US$87,100) per year to cover treatment for their health problems caused by the plant. Two years on, however, the villagers haven’t seen any of it. Only time will tell whether the government lives up to its promise.

After decades of struggles, countless protests and suffering, Mae Moh’s People Right Network did secure a small victory in the form of a land grant consisting of approximately 200 rai (34 hectares) and local government funding to relocate those affected by the power station. They now plan to create an eco-community beyond the 5 km radius of the power station, which is considered a dead zone, where villagers can rebuild their lives.

The hope is that moving out from under the shadow of Mae Moh will allow villagers to regain their strength and help keep the spirit of the struggle against the power plant going.

Story adapted from, Mae Moh: Coal Kills, Greenpeace Southeast Asia, May 2006
South Africa

Disused coal mines – gone, but not forgotten

Veteran environmental activist, Matthews Hlabane, explains how the AMD water flows into this pool. The children from the local community of Maguqa, located about 2 km away, like to swim in the pool as the water is nice and warm. But the warm pools hide a sinister reality. The water is heated by coal fires in abandoned mines – many of which have been burning since the 1940s.

AMD seeps down hill into the Brugspruit stream. The polluted Brugspruit then joins the Olifants River and eventually flows into the Loskop Dam, where large-scale dying off of fish, crocodiles and turtles has been attributed to the contaminated water from coal mines.

Water draining from the mines is filled with sulphate salts, heavy metals and carcinogenic substances like benzene and toluene. The salt in AMD precipitates out covering impacted areas with a thick, white crust as shown here.

Adelphi Magatha and Tebogo Letsulo stand on a field of white salt precipitate from the AMD. They do not know exactly what the precipitate is. They just know that it tastes salty and stings their eyes when the wind blows.

This bright blue-green water flows into the Olifants River and eventually the Loskop Dam. The water contains a mixture of AMD from local coal mines and sewage from the local municipality’s dysfunctional sewage works.

Ponds of AMD water are hidden between Eucalyptus trees in the hills above the dysfunctional water treatment plant in the Brugspruit valley near Emalahleni. The full extent of these ponds – about a 15 km stretch according to a local guide – can only be appreciated from the air.

South Africa is the world’s sixth largest producer of coal – and the seventh largest consumer. With shallow coal seams and cheap labour, coal mines have sprung up all over the country. However, there’s a hidden cost to mining that only starts when the mine has served its purpose.
‘South Africa is the world’s 6th largest producer of coal and the 7th largest consumer.* In 2006, about 80% of South Africa’s coal exports landed up in European power stations.’**

The polluted water turns a yellow orange colour as a result of iron oxide, known to miners as “yellow boy” from the yellow precipitates it forms. This water is highly acid, mobilizing heavy metals from the sediments over which it flows.

AMD leaching from a working open pit coal mine in the Brugspruit Valley. According to locals, the mine is not permitted and therefore operating illegally. AMD, together with failing sewage works, pose the biggest threat to the quality of South Africa’s limited water resources.

Young boys from the Maguqa township play in and around a stinking stream, the result of untreated sewerage from the municipality. Their parents say the stream is dangerous. The children strip to their underpants when they jump over it to keep their clothes dry in case they fall in. That way there is no evidence of their adventures.

The figures for 2007 are production of 283.365 million and consumption of 194.611 million short tons.

There are hundreds of unused, abandoned coal mines around South Africa. Each one is a ticking time-bomb for the environment, mainly due to Acid Mine Drainage (AMD) – water draining from the mines filled with sulphate salts, heavy metals and carcinogenic substances like benzene and toluene. This AMD damages wildlife and spreads illness and disease. According to the Department of Water Affairs and Forestry, coupled with failing sewage works, AMD also poses the biggest threat to the quality of South Africa’s limited water resources (see Coal’s Aftermath).

The effects of disused mines, first hand

One place that feels these effects most shockingly is Emalahleni.113 The name means ‘place of coal’, hardly surprising considering that it is surrounded by 22 collieries – plus steel, vanadium and manganese plants.

One of the biggest abandoned mines in the area is the Transvaal and Delagoa Bay (T&D) mine. It was opened in 1896. When it closed in 1963, it was left ownerless and abandoned – and free to pollute.

Health problems

Among the most vulnerable in Emalahleni are the children of Nyerere Street, in Maguqa. Their soccer field lies in a small floodplain on the side of a small stream. The stream is dirty and dangerous, filled with untreated sewage from the municipality.114

Last summer, a surge in the water level deposited white salt residues over their soccer field115 – all from AMD running from the surrounding mines. They were forced to move their field when the salts started stinging their eyes.

When not playing soccer (among other things), the children of Maguqa swim in the warm water two kilometres upstream. The warm pools hide a sinister reality – the water is heated by coal fires still burning in the abandoned mines, many of which have been burning since the 1940s.

Shocking, the pool is easily accessible and there are no warning signs. This is despite the fact that the water is so poisonous, it can’t be used for irrigation let alone for swimming and bathing.116

Damaged water supplies

In 2006 and 2007, there were three separate incidents around the Loskop Dam, about 60 kilometres downstream from Emalahleni. AMD leaked into the water supply, killing thousands of fish, crocodiles and freshwater turtles. On its way down the river, it also damaged farms and poisoned the water used by communities along the way.

Dr Jan Myburgh, veterinarian and academic at the University of Pretoria, called the situation “an ecological catastrophe.”117 Worse is that the nature of AMD means the damage to the water supply is set to continue in the long term, because once the mine has breached the water table, underground rocks are exposed to oxygen and rainwater. This exposure sets off chemical reactions that release the toxic substances in AMD.

Moving further up the river, there are hundreds of AMD dams over a stretch of more than 10 kilometres. The water is stained red and gold by dissolved iron. Everywhere the landscape dips, you’ll find AMD leakage. It scorches the soil and kills off all the vegetation it touches. One look at the Brugspruit River, and you’d be forgiven for thinking it had been snowed over – but it’s actually salt from the white salt residue.

“One place is hell on Earth”, says veteran environmental campaigner Matthias Hlabane. “The soil is burning and full of salt, the water is contaminated, the air is dangerous. And we don’t see it being fixed.”118

Air pollution

Ermalahleni is in the Mpumalanga province – and the air pollution from coal fires in the disused mines is having an impact on the entire region. Nobody has calculated the costs yet, but as health suffers the reality is beginning to hit home. Officials in the Mpumalanga province have talked about “a definite trend towards increased lower respiratory tract infections in children under five years of age in Mpumalanga in the winter months”.119

In November 2007, the national government declared an area of Mpumalanga – over 301,106 square kilometres – as a national pollution priority area.120 Having measured the ambient air pollution, it is thought to be worse than that in the former East Germany.121

The outlook

South Africa is betting on unproven clean coal technologies and expensive nuclear power plants to deal with climate change challenges, while at the same time doubling its electricity production by 2050 in the face of an electricity supply crisis that sees regular blackouts.

Coal-fired electricity generation and coal mining are expanding, while dealing with the pollution from abandoned mines is a low priority.

The Geosciences Council, an advisory body to the Department of Minerals and Energy (DME), is putting together a list of 6,000 ownerless mines that need urgent action.122 The T&D mine tops the list, with an estimated clean-up cost of around 100 million Rand (US$10.7 million). This represents a small part of the much larger total clean-up cost for all mines of R30-100 billion.

Clearly, the financial cost is huge. While some mine owners – like Anglo Coal and BHP Billiton – are now treating their own AMD at a cost of R300 million (US$32.5 million),123 these are isolated cases. The majority of the cost for the clean-ups will be borne by the public, either as ongoing environmental damage, or as treatment from the public purse.

Story by: Victor Munnik

Coal’s Aftermath

The legacy issues associated with coal include a great deal of water pollution. AMD is just one of them. It can cover rivers, estuaries and sea beds in an orange blanket of iron hydroxide, killing all plant and animal life in its path. Water that has come into contact with AMD is undrinkable for humans, and too toxic for use in irrigation and agriculture.114

It is difficult to make an accurate estimate of the scale of the pollution caused by AMD. However, by 1989 it was estimated that about 19,300 km of streams and rivers (nearly three times the length of the Nile), and about 72,000 hectares of lakes and reservoirs across the world had been seriously damaged.15 As sources of AMD remain toxic for hundreds of years, these numbers will only have gone up since then.

Coal combustion wastes (CCW) are another part of coal’s legacy that often degrades water resources. Left over after coal is burned, it contains toxic substances like arsenic, cadmium, chromium and lead, which can destroy ecosystems completely. Typically, the solid portion of CCW is disposed of in landfill, while liquid fraction is pumped into natural watercourses (see AMD). Costs of CCW are also used to store CCW, alongside waste from the mine itself. Left unregulated, as these dumping grounds often are, there is a high risk of leachages and contamination of local ground water, leading to contamination of drinking water, arable land and livestock.
Belchatów power plant in the Łódź Region is the largest in Poland, supplying almost 20% of the nation’s energy. It’s also the largest brown-coal power plant in Europe.11 Each year its chimneys belch more than 31 million tonnes of carbon dioxide into the atmosphere.11

A large portion of the coal that supplies Belchatów comes from the nearby opencast mine. Mines such as these in Poland have caused the water levels of nearby lakes to drop dramatically. Mining operations occur in Poland at a massive scale. The depression pit for this mine covers an area that is approximately 500 sq-meters.

Plans to expand mining in Poland are underway. One of the big worries is how this expansion may affect local water bodies, such Lake Gopło. The fragile ecosystem around this lake is home to bird sanctuary of Europe-wide significance.

In Eastern Europe, Poland is the largest producer and consumer of coal; in fact, it is the second largest coal producer and consumer in all of Europe, outranked only by Germany.

The Belchatów Lignite open pit mine is the biggest man-made hole in Europe. Poland’s generates more than 90% of its electricity from coal. The wind park in the background shows that there is the potential to for Poland to better harness the power of clean energy.
A large portion of the coal that supplies Belchatów comes from the nearby open cast mine. The changes in the landscape already caused by this mine are plain to see. Located just a dozen kilometres from Belchatów town, the mine area covers 2,500 hectares—the same as 3,500 football pitches. The mine itself is promoted as Europe’s biggest open cast coalmine. The burnt-out landscape surrounding it is littered with heaps of coal waste, trucks and excavators. Deep in the mine, conveyor belts slither along, laden with earth and rock. On the observation deck built around the hole, people fall silent; the view has a sobering effect.

More damage to come

Plants to expand mining in Poland are underway in several other areas—some of which are dangerous near Poland’s famous lake, the cradle of the state. One of the big worries is the effect mining will have on the water levels in these lakes, along with the fragile ecosystems and valuable tourism trade that rely on them (See Disappearing Act).

Kleczew

Kleczew

A similar situation has unfolded near Kleczew, a few kilometres from Przyjezierze. Here, the Jóźwini B&B mine began operating ten years ago and is still running at full steam today. In the intervening decade, the mine has created a dark grey desert landscape that stretches as far as the horizon. Experts at Poznań’s University of Agriculture have found that “water drainage around the brown coal mining areas in the Kleczew region has led to the formation of expansive craters of depression. As mining has expanded northward since the late 1960s, the water levels of lakes across the Powidzki Landscape Park have begun to fall.”

Kruszwica

Kruszwica

Another location set to suffer is Lake Gopło. Situated near the town of Kruszwica, it is home to Gopło Millennium Park (Nadgoplański Park Tysiąclecia). This park is protected by the EU Natura 2000 programme and contains a bird sanctuary of Europe-wide significance. It was also along the banks of Lake Gopło that the history of the Polish tribe first started. Now this valuable and delicate area is under threat.

This threat comes from excavation rights for the Tomiła mine opencast mine (less than 10 kilometres away from Kruszwica), which were signed on 2 February 2006. The mine is due to open in 2009. Two months after this announcement, local residents organised a protest against the plans—one of the first protests of its type in Poland. About five thousand people demonstrated along the streets of Kruszwica. One of them was Józef Dróżdżewski, of the Przyjezierze Association for Protecting the Natural Environment. “If Tomiła starts mining” he argued, “Lake Gopło’s water level will shrink over the coming decades similarly to the developments at Lake Ostrowskie.”

It should come as no surprise that this claim is not backed up by the Tomiła mine’s Environmental Impact Report, commissioned by the coal mine itself. According to this report, an advance decision to start developing coal mine water in Lake Gopło from 2017 would “permit hitherto water levels in the Lake to be maintained.” If this were not the case, a substantial change in water levels would have devastating effects. This could occur immediately, if too much or too little water is fed into the lake. Devastating effects could also occur years later, when the mine stops operating and the lake starts to dry up. Lake Gopło is an important part of the trophic chain of all the surrounding lakes. Many species of birds would be in danger, including the little bittern, the bearded reedling and the greylag goose – the symbol of Gopło Millennium Park. Marshes and peat bogs would also dry up, causing irreversible destruction to the richest amphibian reproduction areas in the Kuyavia Region.

Despite this, the mining company refuses to look these facts in the face. “I can’t understand why Kruszwica has become so involved. It’s located in an area where future mining won’t have the slightest impact on it,” Arkadiusz Michałski, chief environment protection engineer at KWM Korin has stated. Dr Michał Kuczyk, ornithologist at Poznan’s Adam Mickiewicz University disagrees. “We’re not talking about the area immediately next to the mining operations,” he states. “We’re talking about an impact on regions tens, if not hundreds of kilometres away.” If he’s right, the damage in Poland caused by open cast mining has only just begun.

Story written by: Marta Kazimirowska

Disappearing Act

Coal mining has wide-reaching effects on local water resources. It requires tremendous volumes of water for mining operations. Often, land areas as well as rivers are drained to get coal out of the ground and consequently whole water bodies disappear.

When coal is excavated from deep underground, groundwater is pumped out to dry up the areas being mined. Removing vast amounts of water often drains water from an area beyond the immediate coal-mining environment. As a consequence, water tables are lowered, natural ecosystems damaged, the growth and reproduction of aquatic plants and animals disrupted, valuable recreational fish or bird species diminished and whole regions endangered—often across national boundaries.

Surface mining operations, such as Mountain Top Removal (MTR), can cause water resources to disappear in another way—by covering them under mounds of dirt. MTR operations literally dump mountains into streams. In what the industry terms as “valley fills”, rubble generated by blowing up the mountains is dumped into neighbouring valleys, burying acres of wildlife habitat and permanently destroying the ecological functions of the affected streams. In the US, over 1,200 miles of streams have already been buried and permanently destroyed in the central region of Appalachia while community members have been drastically affected. By themselves, these valley fills are expected to bury and permanently destroy at least 2,400 miles of streams located in central Appalachia by 2013.
US: Eastern Kentucky

Turning mountain tops into mine waste

MTR operations literally dump mountains into streams. In what the industry terms as “valley fills”, rubble generated by blowing up the mountains is dumped into neighbouring valleys, burying acres of wildlife habitat and permanently destroying the ecological functions of the affected streams.

Largely hidden from most Americans, MTR is a highly destructive form of coal mining. In the US, about 1 million acres have been destroyed by MTR in the central and southern Appalachian Mountains.

As shown here, mountaintop removal systematically blasts apart and dismantles entire mountaintops to access multiple seams of coal (top left). The remaining rock is dumped into valleys below (bottom right).

The central Appalachian Mountain region in the US provides much of the country’s coal. In the early 1980s, coal companies operating there started using a form of opencast mining called mountaintop removal. In the process, they have utterly devastated the land and communities of the Appalachian coalfields, particularly those of eastern Kentucky. Why? Because it’s the cheapest way of getting their hands on coal.

Discarded sign near surface mining on Island Creek in Pike County, Kentucky. On occasion, blasts from the nearby mining site have sent rocks flying onto the Urias’ property and engulfed their home in dust.

Dry ditch on a “reclaimed” site near Erica and Raul Urias’s home on Island Creek in Pike County, Kentucky. There is little evidence to show that reclamation efforts undo all of the environmental harm caused during the mining process.

“When I was a kid it was beautiful over here,” Raul explains. “Now there’s nothing... Now what you have is 100-foot high walls, areas they say are ‘reclaimed’ but they’re not... just dead brown stuff lying there. The wildlife’s gone. There’s just nothing left.”
Mountaintop Removal (MTR) works exactly as it sounds – miners blow up whole sections of mountains to get to the coal below the surface. Once that coal is removed, the vast amount of loose rock and dirt caused by the explosions (called ‘overburden’) is dumped into nearby valleys. This devastating method of mining has already buried hundreds of miles of streams in Kentucky and decimated hundreds of thousands of acres of ancient forest. MTR is wreaking havoc across large swathes of this mountain region – one of the richest temperate forest ecosystems in the world. The physical impact of dumping thousands of tonnes of overburden into mountain valleys is bad enough. But this waste rock and dirt also contains toxic metals such as selenium, arsenic, and mercury that leach into ground and surface water, poisoning everything in its path – streams, fish, flora, fauna, even people.

The effects of MTR first hand

Thousands of people living in the eastern Kentucky coalfields have been directly affected by MTR and can bear witness to the neglect, denial and greed of the coal companies.

Toxic poisoning

Erica and Raul Unas live in what was once a verdant, bird-shaped valley in Pike County. Their home is now surrounded by the moonscape of mountaintop removal and their property has been pelted with flying rocks and engulfed by sulphur-rich dust from mining blasts, but what they worry about most is their four-year old daughter, Makayla.

In 2006, they discovered that the water in which they had been bathing Makayla, and which she sometimes drank, contained 130 times the concentration of arsenic allowed by the EPA, as well as higher than normal levels of mercury. 

During his own childhood, Paul knew this valley as a beautiful place altogether. “When I was a kid it was beautiful over here,” he explained. “The streams ran clear, never black. There were minnows and crawdads, a large amount of frogs. Now there’s nothing. Now what you have is 100-foot high walls, areas they say are ‘reclaimed’ but they’re not – just dead brown stuff lying there. The wildlife’s gone. There’s just nothing left.”

Sheer ignorance

“We found showy orchids; we found trilliums...pipsissewa...just all kinds of wonderful little wildflowers in there.... But, it’s gone, it’s gone. I mean, they completely denuded the whole entire hollow and made it a valley.”

Decades ago, Mary Jane used to lead nature hikes in the part of Leslie county in which she and her husband Raleigh now live. Since 2007, the couple have been fighting the MTR operation of Whymore Coal. During this struggle, they’ve witnessed the complete degradation of this once-pristine ecology.

What makes matters worse is that some this destruction is due to needless mistakes on the part of the coal company, Mary Jane revealed to us that Whymore Coal recklessly slashed a 100-foot wide swath running right along the mountain, cutting away priceless forest habitat for the endangered Indiana Brown Bat. Yet, as the Adameses later found out, the company had slashed the strip in the wrong place. “They didn’t know where the coal seam was,” Mary Jane told us. “I mean, they completely denuded the whole entire hollow and made it a valley.”

Inadequate restoration

“I don’t care how much grassland they put here, [the animals have] to have the nuts to survive on during the winter. The turkey; the grouse, the squirrels, the deer, everything. They’re taking all this big timber out and not replacing it with anything in the future.”

In Floyd County, Kentucky, Rick Hardshore has witnessed the woeful inadequacy of the post-mining reclamation process.

The main problem, Rick points out, is that coal companies most commonly reclaim mine sites as pastureland, planting a mix of seven crops. Not only do these crops need replanting every now and then, they only grow with the help of strong fertiliser. Once the coal company’s bond money is returned by the state, the fertilising stops, and everything dies out.

These inadequate efforts are completely destroying surface and ground water resources along with the ecosystems upon which the local wildlife depend. Rick’s first-hand observations are confirmed by a 2003 report distributed by the EPA. This report stated that “lands reclaimed in this manner will take much longer than observed in old field succession to return to pre-mining forest vegetation.”

In 2003, the company mining near Rick’s property killed an entire stream. According to Rick, the water in the creek ran orange. He describes what happened next:

“There were no fish in the creeks. When you kill what you can’t see with your eyes in the creek, then the salamanders can’t live there, the crawfish can’t live there, the fish can’t live there. Then how about the raccoons that come down and feed on the minnows and the crawfish? They’re not there for them. You kill that one; you kill the chain, their food chain.”

This incident was labelled an accident although there was nothing accidental about the mining company illegally draining an abandoned underground mine without first building a catchment pond. ‘Accidents’ like this have been occurring for decades. The environmental devastation they have caused in Floyd County can be seen across the region.

The outlook?

As long as MTR mining continues, and as long as companies continue to put profit before the health of the land and the people, the outlook for eastern Kentucky and the central Appalachian coal fields is bleak. The price of a ton of coal has skyrocketed, the rush to mine ‘cheap coal’ by MTR is making matters worse, exacerbating the costs of human sickness, contaminated water, and degraded ecosystems - costs that are considered ‘external’ by the mining company. These costs are being paid by the coalfield residents and all those who live downstream. It’s a price they shouldn’t have to pay.

Story by: Sara Pennington

Greenpeace International
The True Cost of Coal
How people and the planet are paying the price for the world’s dirtiest fuel

Mercury

The coal industry is the single largest source of mercury emissions in the world. Over 2.150 tonnes of mercury pumped into the atmosphere each year, over half comes from the chimneys of coal-fired power plants.

Burning coal releases large amounts of mercury present in raw coal into the air. This mercury eventually gets into rivers, streams and lakes, either through rain, dust, or simply by gravity. Once in the water, it finds its way into the food chain – starting in algae and working its way up through fish, then birds and mammals. Concentrations of mercury increase the further up the food chain you go.

Can mercury harm humans? Yes. It’s a neurotoxin that can be passed on from mothers to unborn babies, causing brain damage, blindness, seizures and many other problems. Exposure comes mainly from eating contaminated fish.

In the US, 8% of women of childbearing age have more mercury in their blood than is deemed safe by the US Environmental Protection Agency. This results in about 410,000 children born each year having been exposed to dangerous levels of mercury in the womb.
The 50-year old passenger ship Santa Barbara, named after the patroness of miners, cruises around Lake Zwenkau in East Germany. The former opencast mine is being transformed into a tourist hotspot based on water. Nature conservation only makes up a small percent of recultivation projects. Until the end of 2009, about 14.5 million cubic meters of soil will be moved – to create embankment systems during the flooding of the lake. At 10 sq-kilometres, Lake Zwenkau will be the biggest lake of its kind in the ‘New Central German Lake District’.

The colour of the water is crystal clear like black tea. The pH level of 2.6 is the same acidity as vinegar. The effect of this acid mine drainage: aquatic plants and animals can’t survive, water supplies can become contaminated, and structures like wastewater pipes can be corroded.

“Without the miners, we could not cruise on this lake today”, explains captain Thomas Nagel as he slowly navigates his ship across Lake Zwenkau in East Germany. The water looks like clear, black tea and smells of sulphide. Its pH level is 2.6 – the same acidity as vinegar. In the southeastern corner of the lake, the two grey towers of the coal-fired power station Böhlen-Lippendorf pierce high into the air.

In the southeastern corner of the lake, the two grey towers of the coal-fired power station Böhlen-Lippendorf pierce high into the air. Böhlen-Lippendorf emits almost 14 million tonnes of CO₂ per year and is the 7th biggest CO₂ emitter in the league of coal-fired power stations in Germany.

The opencast mine in Profen supplies the water for the flooding of Lake Zwenkau. Since March 2007, around 10 million cubic meters of water have been re-routed into the lake. This drains other areas besides the immediate coal-mining environment; this results in lowered water tables and damaged natural ecosystems.

“Without the miners, we could not cruise on this lake today”, explains captain Thomas Nagel. So far, the recultivation of Lake Zwenkau has cost €145.6 million. While millions of Euros in public funds are invested in recultivation, scientists state “it is still not clear whether these approaches are sustainable.”
Lake Zwenkau sits on a former opencast mine, 20 minutes’ drive from Leipzig in Saxony. Opened from 1921 to 1999, the mine covered 2,883 hectares – the size of more than 4,000 football pitches.64 Now, thanks to recultivation, the site is being transformed into a tourist hotspot, complete with a marina, swimming apartments and an aerial railway across the lake to the nearby amusement park, Belantis. At 10 kilometres2, it will be the biggest lake of its kind in the so-called ‘New Central German Lake District’.65

Lake Zwenkau is one of many projects set up to recultivate the scarred surface of former opencast mines in Germany. However, it also highlights some of the many challenges that come with recultivating land desecrated by opencast mining, along with the flaws in the way governments are currently going about it (See Reclaiming What’s Lost).

Recultivation – problems and flaws

Who pays for it?

The recultivation of Lake Zwenkau has so far cost €145.6 million.66 In the Central German and Lusatian region alone, €9.3 billion have been spent on the restoration of former opencast mines since 1990.67

The way Germany pays for this recultivation is relatively unique: in the former German Democratic Republic (GDR), opencast mining was run by the government. As a result, so is recultivation.68

Phyllis Steuer, from the environmental organisation Ökolöwe in Leipzig, explains the problem with this:

“Recultivation is associated with tremendous costs. Usually, the mining companies need to bear the costs, which is the only acceptable option. But in the East German case, the costs for recultivation have been taken on by the public authorities. This is only justifiable with respect to the governmental organisation of lignite surface mining in the former GDR… That further costs are currently covered by the EU, in the framework of so-called ‘regional aid’, is a non-justifiable cross-subsidisation of landscape-wrecking surface mining.”

Another example is the Lusatian region, where recultivation projects also rely on active flooding with river water. Here, the flooding of the Lusatian Lake District severely affected the surrounding rivers Spree, Neiße and Schwarze Elster. In 2003, so little water of the Spree actually reached Berlin that the discharge of the capital’s waste water actually changed the direction of the river.69

As if that wasn’t enough, the Lusatian region now struggles with another problem with water levels – after the drainage pumps were switched off in 18 of the region’s closed-down opencast mines, groundwater levels rose dramatically.

The result of the rises? Harvested fields, basements were flooded and buildings cracked apart. Sewage treatment plants and cemeteries could be affected.70 “This is a new phenomenon. None of us had water in our basements before,” stated Sigemar Kugler, deputy district mayor of Zerres and member of the ‘Watergroup’ Spreeal, a group that documents the rise of groundwater in the municipality.71 Despite the fact that 100-year old houses had never flooded before surface mining started, the LMBV only accepted responsibility in late 2008.72

Until then, residents had to install pumps themselves to keep the water under control.

Acid mine drainage

There are 172 post-coal mining lakes in East Germany, and around most of them suffer from a similar problem – acid mine drainage. The consequences are easy to see: aquatic plants and animals can’t survive, water supplies can become contaminated, and structures like waste-water pipes can be hit by acid corrosion.73

Lake Zwenkau is no exception. Only last year, Jörg Hagedorn of the environmental department at the regional council of Saxony publicly declared, “Lake Zwenkau will turn into the most acidic Lake of Germany, if we don’t do anything.”74

Damage to water levels

To dilute the acidification of Lake Zwenkau, the LMBV currently relies on ‘active flooding’. Since March 2007, around 10 million cubic meters of water have been re-routed into the lake75 from the drainage of the open-cast mine in Profen.76 Removing such vast amounts of water drains other areas besides the immediate coal mining environment. The result is lowered water tables and damage to natural ecosystems.77

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Reclaiming what’s lost

Mining takes functioning ecosystems and reduces them to piles of sand tellings, overburden and rock. At just a single mining site, millions of cubic metres of soil can be moved over the life of the mine. The devastation is so complete that much of the land never recovers.

In some parts of the world, reclamation (also known as recultivation or rehabilitation) activities attempt to return some ravaged areas to productive land. However, the extent to which impacted land can be repaired after mining is open to debate. Mountaintops cannot be replaced once blown apart, valleys and streams buried under millions of tonnes of earth won’t be restored and cavernous pits created by open-cast mining are likely to remain that way. Mining so fundamentally alters natural systems that what is lost can never truly be regained.

In places like the US, there is little evidence to show that these efforts can undo all of the environmental harm caused during the mining process. Much of this is because of the poor quality of the soil on reclaimed sites. Soil in an undisturbed system is a dynamic medium, varying in its composition and learning with life. Soil is found at reclaimed sites. Lack structure are largely bankrupt from a nutrient perspective, and devoid of insect and microbial life necessary to sustain plant life. As a result, planting success rates tend to hover around 50-30%, in some areas where others only 10% of new seedlings survive.79

Skirting the real issue

No one knows whether landscapes can ever be restored to resemble their natural state.101 While millions of Euros in public funds are invested in recultivation, scientists state that “it is still not clear whether these approaches are sustainable.”102

Of course, one of the biggest issues with recultivation is that, in one sense, it’s a dangerous diversion – it takes people’s eyes off the fact that opencast coal mining still happens. No matter how effective recultivation is, these gigantic projects do not legitimise opencast mining – the most damaging of mining techniques.

All the while the public pays for recultivation, the German government is still subsidising coal. Contrary to all declarations by the coal industry, the 2004 study of the Federal Environment Agency showed that taking the effects of lignite into account, as well as direct state subsidies, amounts to €6.5 billion a year.103

The outlook

The mining continues

In August 2008, Saxony’s Prime Minister Stanislaw Tillich announced that he continues to stand for an energy-mix that includes lignite, the dirtiest type of coal (See Appendix E: Coal Basics).104 Dr. Joachim Geisler, chairman of the Central German Lignite Company MIBRAG stated that the company will invest €23 million to modernise surface mining machinery in 2008. That is in addition to talking intensely with partners “about a new development of a coal-fired power station in Profen.”105

This means that the massive mining machines will continue to cut through the country. People are still being resettled. Forests and whole ecosystems are still being destroyed.

“With the continuation of surface mining, we delay and displace the restoration of whole landscapes,” says Dr. Werban, former head of the UNESCO-Biospherereservoire Spreewald.106 “We could save millions in recultivation, if we would respect nature more and not try to force everything through with raw violence. Everything is geared towards commerce and only an infinitesimal percent of recultivation is dedicated to nature conservation. There is too little left for nature.”107 It seems nothing has been learnt from the past. “But nature is reclaiming its share back”, Dr. Werban predicts.

Story by: Nina Schulz
Australia

King Coal’s dirty throne

The port of Newcastle is the world’s largest coal export point, currently exporting 80 million tonnes of coal annually. Plans are underway to expand capacity over the next five years to at least 120 million tonnes annually and even as much as 200 million tonnes per annum.

Australia is heavily dependent on coal, with over 80% of electricity sourced from coal-fired power. But this comes with a heavy cost. A Greenpeace report demonstrates how Australia can reduce reliance on coal and generate over 40% of its electricity from renewable energy by 2020.

While coal companies and governments cannot get Hunter Valley coal out fast enough local farmers and residents are alarmed at the environmental and social impacts of coal dependency. There is a growing community belief that the costs of the region’s coal industry vastly outweigh any perceived benefits.

Coal is king in Australia, and the Hunter Valley region in New South Wales (NSW) is its throne. Most coal mining in Australia is opencast, meaning a journey through the Hunter Valley can often be mistaken for a trip to the moon, with massive mines stretching out over the horizon.

Local residents protesting the proposed opencast mine at Anvil Hill. The mine would cover more than 3,500 hectares and destroy vast areas of the local environment.

There is every reason to stop Mangoola from going ahead. Not only would an expansion of mining exacerbate existing water scarcity issues but it would force more than 200 residents to relocate.

This wind turbine at Kooragang is a reminder that a more sustainable solution is possible. Research has shown that the Hunter Valley could provide 40% of New South Wales’ energy from renewable sources by 2020, creating more than 10,700 jobs in the process.
Continuing the destruction: Anvil Hill

Despite the obvious and dramatic damage coal is inflicting on Hunter Valley, plans are in place to double the export capacity of Newcastle and several new coal mines are proposed to supply this extra coal.

One of these new mines is the proposed ‘Mangoola’ open-cut mine at Anvil Hill. The plan for the mine is massive – with a project area of more than 3,000 hectares and seeking to extract more than 220 million tonnes of coal over two decades.174 Just a single year’s worth of coal from the mine would produce as much CO₂ as the entire transport sector in New South Wales. The mine would operate 24 hours a day, 7 days a week, with a noise impact “almost five times greater than the impact of any approved mining project in NSW”.175

Local bushland facing extinction

Anvil Hill contains some of the last remaining bushland in the Hunter Valley. It is home to 440 flora and fauna species – 25 of which are listed as threatened.176 The area is sufficiently sensitive and ecologically unique that a report in 2005 recommended that Anvil Hill should be protected by making it a nature reserve or managed trust reserve.177 If Mangoola and other proposed mines go ahead the expansion of mining will threaten some 1,300 hectares of this high quality habitat. Migratory species outlined in the Environmental Assessment conducted for the proposed mine would not adequately compensate for this loss.178

Threat to industry and community

There is every reason to stop Mangoola from going ahead. Not only would an expansion of mining exacerbate existing water scarcity issues but it would force more than 200 residents to relocate. The horse-breeding and wine-growing industries have been vocal in their opposition to the Mangoola mine, the Upper Hunter Winemakers Association noted:

“Many longstanding, sustainable agricultural enterprises will be displaced by this mine, impacting the existing communities and families that have, in some cases have been in operation for generations.”179

Other constituencies, including local residents, have grave concerns about the proposed mines at Anvil Hill. To argue their case, the Anvil Hill alliance was formed in 2005. This local action group has gained support from a number of NGOs and has been actively campaigning to have the plans for the mine rejected since its inception. In June 2007, more than 400 people spent the weekend camped out on the proposed site, spelling out the words “Save Anvil Hill” in a clear message to the State Government. Even people who have worked in the coal industry think opening up new mines is a step too far. One example is Graham Brown, a retired miner who supports a shift away from coal in the Hunter Valley. He’s keen to see jobs and the local economy protected in the shift to a low-carbon economy, telling us that “We need a transition mechanism in place, fully funded by the coal companies.”180

The future

A more sustainable solution is possible – and it’s one that local people and environmental groups have been fighting for. Research has shown that the Hunter Valley could provide 40% of New South Wales’ energy from renewable sources by 2050, creating more than 10,700 jobs in the process.181 In fact, with the help of the existing infrastructure, Hunter Valley could actually become a renewable energy-exporting region, sending emission-free electricity around the state, while developing clean energy technologies for the rest of the world.

Sadly, the reality is not so positive. Shortly after World Environment Day in June 2007, the New South Wales Government approved Anvil Hill’s transformation into a coal mine, despite the many reasons not to go ahead with the plan. The mine has since been sold to Swiss multinational, Xtrata, in late 2007, having become too much of a liability for it’s previous owners Centennial Coal. The good news is that the mine remains undeveloped, whether that stays the case in the future is as yet unclear.

Story by: Julian Vincent
Philippines

Iloilo City – standing up to ‘big coal’

Hundreds of people take part in a Renewable Energy Parade on the Global Day of Action against climate change. They are calling for the immediate passage of a renewable energy bill in the Philippines to help catalyze a shift away from fossil fuels.

Greenpeace activists dump 20 sacks of charcoal in front of a Metrobank branch. Metrobank, one of the largest banks in the Philippines is behind the plans to build the coal-fired power plant in Iloilo City.

Iloilo residents of all ages visit the Climate Defenders Camp to learn about climate change and how clean energy sources can provide electricity for the Philippines.

On World Environment Day, Greenpeace volunteers install solar panels as part of the construction of a Climate Defenders Camp on the grounds of one of the city’s biggest cathedrals.

Hundreds of students from St. Paul’s University in Iloilo City form a human banner that spells out ‘QUIT COAL’. These students are part of the movement that is calling on local and national government officials to reject new coal-fired power plants.

Thousands join an ecumenical prayer rally in Iloilo City. They are protesting against the proposed coal-fired power plant while supporting more sustainable energy solutions.

Iloilo City, whose province is better known as the “heart of the Philippines”, is a city divided. The reason? A new coal-fired power station currently on the planning table.
The Catholic Church is one of the leading opponents of new coal-fired power plants in the Philippines. The President of the Catholic Bishops Council of Philippines, Archbishop Angel Lagdameo, leads an interfaith rally to show proponents of the coal-fired power plant that they are not welcome in Iloilo.

As part of the activities in the Climate Defenders Camp, Greenpeace volunteers plant around a hundred windsocks at the site of the proposed power plant. The windsocks represent the massive renewable energy potential on the island that is waiting to be tapped.

Greenpeace demands that Metrobank invests in renewable energy instead of coal to enable sustainable development. In protest of the bank’s investment strategies, many people in Iloilo City close their bank accounts at Metrobank.

“As long as there are dedicated and selfless citizens who are for sustainable development, RISE will continue campaigning and serve as watchdogs for the environment.”

As you enter the city, the division is easy to see. Hundreds of banners have been hung up around the city. Half say “yes to coal”. The other half say “no to coal”. A closer look at the banners shows that the “yes” banners are expensive and professionally printed. The “no” ones are almost all hand-painted. Here lies part of the problem; support for the new power station comes from government officials and rich business groups. In contrast, the fierce opposition comes from a vast and diverse alliance of citizens including the influential Catholic Church, doctors, professors, engineers, enlightened businessmen, civic leaders, and students. Overall, one thing becomes clear: instead of seriously addressing the issue of climate change and its effects on the poor, the Arroyo government is promoting privatization and expansion of Philippine coal power plants. But, the opposition is growing (See Growing Resistance).

Opposition RISEs up

Despite their diversity, the opposition has become organized. In 2003, this group of citizens founded Responsible Ilonggos for Sustainable Energy (RISE). Their first aim was to stop the construction of a coal-fired power plant in the fishing village of Ajuy in Northern Iloilo to promote sustainable development through renewable energy.

RISE was immediately effective. It was able to delay the power plant in Ajuy until the funder, KEPCO, eventually pulled out and transferred the project further south to the coastal town of Banate in the hope of facing less opposition. Here again, RISE convinced the Provincial Board to turn down the proposal. Sadly, this wasn’t the end of it. The plan for a coal-fired power plant was moved again, this time to Iloilo City, and RISE moved with it.

Aurora – a story of resistance

Aurora Anti-Lim is a determined lady. Recently retired Assistant to the Central Philippine University President on Environmental Concerns, she produces and co-hosts an environmental talk show on the university TV channel and is one of the leaders of the RISE campaign. “The greatest challenge,” she told us, “is the apathy of the national and city government to global warming. They endorse use of coal for energy generation despite our warning against severe impacts of climate change.”

This concern over the effects of climate change is a serious issue for the Philippines. The archipelago was listed in 2007 by the NGO Germanwatch as the country most at risk from the effects of climate change. The country is already hit by more severe and frequent typhoons, as in November 2007 when more than 200,000 people were evacuated. It also suffers droughts, and the 7,107 islands are threatened by rising sea levels. Yet in spite of this, the government perseveres with coal.

Fighting lies

Much of the work of Aurora (or Tita Au, as friends call her) and her group of environmental advocates is centered around countering the lies and half-truths spread by the coal supporters. She says that much of the enthusiasm for coal in Iloilo City is based on falsehoods: “There is a ground swelling of support for coal-fired power plants in the country due to misinformation that includes ‘clean coal technology’ and the misleading argument that coal is cheap.”

It is easy to see why these claims seduce. Iloilo’s main energy source is an off-grid 72 MW diesel power plant. Because diesel is so expensive the electricity rate in the city is among, if not, the most expensive in the country. What’s more, the city also experiences frequent power outages. The power station proponents attribute this to a lack of supply but the truth is that a new coal-fired power station in Iloilo City will not solve these problems. Too little power is not the issue. Disruptions in electricity are actually due to problems in transmission and distribution. Any electricity price drop that might come after a new power station is built will be paid for in impacts on those living in the community. Aurora remarks, “It will be the people who will have to bear the health and environmental costs of burning coal.”

Despite their uphill battle and the power and influence of coal plant proponents, Aurora isn’t intimidated. She, and others like her, work ceaselessly to call attention to the urgency of the climate crisis and our global need for more sustainable energy sources.

Fighting for a sustainable future

Thanks to the work of people like Aurora, RISE is gaining momentum. In March 2008, thousands followed a call by the Catholic Bishops Conference of the Philippines (CBCP) to take part in an ecumenical prayer rally in Iloilo. The rally demonstrated against coal, and campaigned for the right to choose a sustainable development path. Even the governors of neighbouring provinces have spoken out against coal, and have set examples by securing their provinces’ future energy supply with small-scale hydro and wind turbines.

Yet Iloilo officials are still falling for the industry’s claim that coal is the best possible source of energy for Iloilo, despite the availability of affordable alternatives. As Aurora pointed out to us, “There are several sources of energy which Iloilo can tap. We are campaigning for an increase in the transmission of geothermal energy, solar, wind, hydropower, and biomass for cogeneration.”

The outlook

The protests in the last year did have some effect, as the Department of Environment and Natural Resources (DENR) froze the environmental certificate of compliance (ECC) for the planned power plant for several months. But it wasn’t enough to stop it completely. Despite a strong and organized opposition, the certificate was granted this past September.

While this condemns the region to an as-yet unknown human cost, it’s not the end of it. RISE doesn’t even think about giving up:

“As long as there are dedicated and selfless citizens who are for sustainable development, RISE will continue campaigning and serve as watchdog for the environment.”

In Iloilo, a dedicated local group of activists fully understand the impact coal will have on their community, damaging human health, ecosystems, and quality of life. In their fight, they are also defending all the planet’s inhabitants from devastating, runaway climate change.

Story by: Mareike Britten

Growing Resistance

In 1844, legendary social theorist Friedrich Engels spoke of “an industrial revolution, a revolution which at the same time changed the whole of civil society.” Coal played a central part in this. Today, coal powers a different kind of revolution, one where resistance movements are forming against its continued use. In the places profiled in this report and elsewhere, communities around the globe are rising up and saying no to coal—organizing protests against proposed power plants and open cast mines, occupying building sites and blockading coal trains and shipments.

In Poland, about 5,000 people took to the streets in Krużewica in April 2008, to oppose the plans for an open cast mine near Poland’s cradle of cultural heritage and nature reserve, Lake Golpo. This was the first protest of its kind in the country’s history. In Australia, an alliance between thoroughbred horse breeders, vineyard owners and local residents formed to oppose a new open cast mine in Avelil Hill. Disguised as railway workers, protesters in the UK stopped a coal train on its way to the nation’s largest power plant, Drax Power Station, in June 2008. Some climbed onto the train and unloaded almost 20 tonnes of coal onto the tracks. Others chained themselves to it. “Leave it in the ground”, read the banner, which activists unfurled during their action.

In the autumn of 2008, anti-coal activists in Germany started a petition for a referendum to stop further site developments of surface mines in the federal state of Brandenburg.

All of these actions demonstrate that resistance against inhumane, climate-destroying and harmful practices such as burning coal is growing and set only to get stronger.
We’ve exposed the destruction caused by mining – from black lung disease to coal fires and acid mine drainage. We’ve uncovered the effects of coal-fired power plants locally and globally, including the urgent threat of greenhouse gases building up in the atmosphere. We’ve also spotlighted coal’s legacy – the often-forgotten harm caused by abandoned mines and the reclamation attempts that never really work.

Finally, with the analysis of CEDelft, we’ve put a price tag on some of the more conspicuous ‘external’ costs associated with coal’s chain of custody on a global scale. The total came to roughly €360 billion a year – a staggering number that nevertheless is likely to be an underestimation. It is simply impossible today to assess all potential emissions and precisely quantify every incidence of damage induced by coal around the world.

The true cost of coal underlines the urgent need for action to avoid the disastrous consequences of a coal-powered future. Indeed, coal must be phased out if we are to keep global temperature rises as far below 2°C as possible (compared to pre-industrial levels) and avoid catastrophic climate change. However, even in the face of climate change and all the other costs that come with coal, still many countries harbour plans to build new coal-fired power stations. If all current plans are realised, CO2 emissions from coal will increase 60% by 2050. Not only is this a totally unsustainable plan for the future, it’s an unnecessary and dangerous one.

There are options available to us other than coal – options that work. Greenpeace’s Energy Revolution provides a practical blueprint that shows how renewable energy, combined with greater energy efficiency, can cut global CO2 emissions from fossil fuels by 50%. This solution provides the same level of energy ‘services’ while phasing out reliance on coal.

This is possible because decades of technological progress have moved renewable energy technologies into the mainstream – technologies like wind turbines, solar photovoltaic panels, biomass power plants and solar thermal collectors. The market for renewable energy is also growing dramatically; in 2007, global annual investment in renewable energy exceeded US$100 billion. At the same time, our use of energy is shamefully inefficient; a large proportion the coal being burned for power is just being wasted which can be easily avoided through available technology measures.

Leaving coal behind is the only way forward. The world simply cannot afford to continue with it – the costs to the climate, our planet and ourselves is much too high. Coal may have been essential in powering the Industrial Revolution, but now it’s time has passed. We must now bring about a revolution of another sort – one powered by clean, sustainable energy solutions that will protect our climate, health and environment now and for generations to come.
Coal Basics

Assembled here are the basics on coal: its different types, how it is mined, technologies used to burn it and how much countries have, produce and consume every year.

Coal types
Coal is a fossil fuel. This means it was originally organic matter (wood and leaves) that was subjected to pressure and heat, taking on a compacted, carbon-rich form over millions of years.

The quality of coal depends on its carbon content, which in turn depends on what temperatures and pressures the coal formed under. The higher the carbon content of coal, the higher its energy value and the more heat it produces when burned. This energy value is usually measured in British Thermal Units (Btu value). The Btu value of different coals can vary enormously. For example, peat has a Btu value of 4,500, while the value for the hardest coal can be over 14,000.

There are many different types of coal, but most fall into one of four main categories.

Lignite (also known as brown coal) has the lowest carbon content and the highest amount of moisture. It’s geologically younger than other forms of coal, and mostly used in power generation. Brown coal is the dirtiest coal type as the process converting it into usable energy is very intensive. For example, it takes five tonnes of lignite to yield the equivalent energy level of one tonnes of hard coal.

Sub-bituminous coal contains more carbon and less moisture than lignite. Like lignite, it is used for power generation. It is also used for other purposes, including making cement.

Bituminous coal is considered a hard coal, with up to 95% of its weight in fixed carbon (the carbon that remains in the coal after volatile material is taken out before burning). As well as being used in power generation, it’s often turned into coke to be used in iron and steel manufacturing.

Anthracite is the hardest type of coal – often with more than 90% of its weight in fixed carbon. Because of this higher energy value, it’s used in heating.

Coal mining
Coal is mined in either opencast (also called mountaintop, surface or strip mining) or underground mining. Each approach carries with it different costs, health and safety as well as environmental issues.

Opencast mining
Opencast mining is used if coal seams are found near the surface of the earth. It’s cheaper than underground mining and arguably more ‘efficient’, as coal recovery rates are 90%. In opencast mining, the earth and rock above the coal seam (called overburden) is broken up by explosives and taken away. The exposed coal seam is drilled so it fractures, and then the loose coal is removed.

Open-pit mining is the most common method of mining. It is used when the coal seam is close to the surface and the overburden is not too thick. This method is used for mining coal that is not too deep, and is suitable for large-scale operations.

Underground mining
Underground mining is used to reach coal buried too deep for opencast techniques. It’s less efficient, more labour intensive and more expensive than opencast mining. But since most of the world’s coal is buried deep, the majority of the world’s coal mines are underground.

There are two main underground mining methods – Room and pillar and Longwall mining. Room and pillar mining is used for shallower coal seams. It involves cutting rooms into the coal seams and leaving pillars of coal to support the roof (hence the lower recovery rate). Longwall mining has a higher recovery rate because it uses mechanical shearsers to mine the coal and power supports to keep the mine stable. After the support structures are removed away, the mine collapses.

Underground mining brings huge amounts of waste earth and rock to the surface – waste that often becomes toxic when it comes into contact with air and water. Underground mining also causes subsidence as mines collapse and the land above it starts to sink. Subsidence can cause serious structural damage to homes and buildings and can tear up infrastructure like highways, buildings and bridges. In Australia an earthquake caused by underground mining in 1899 destroyed hundreds of homes, killing 13 people and injuring another 165. The costs caused by the disaster were higher than the profit the mine had generated since its opening 90 years earlier.

Less catastrophic effects attributable to subsidence include soil erosion, disruption of surface and subsurface drainage and wet or ponded areas. It also lowers the water table, changing the flow of groundwater and streams.

Coal combustion technologies
There are three types of coal power plant currently in use to create electricity:

Pulverised coal-fired (PCF) power plants
In these plants, the coal is ground into a fine powder and blown into a boiler. The coal is burned at between 1,300°C and 1,700°C, creating steam which drives a steam turbine.

Pulverised fuel combustion (PFC) plants
In these plants, the coal is mixed with other fuels like biomass. Thermal efficiencies range between 40% and 44%. The lower combustion temperatures in PFC systems and cuts the amount of NOx produced.

Fluidised bed combustion (FBC) plants
Here, coal is burned with air in a fluid bed mixing gas and solids. This is done either at ambient pressure (called Atmospheric FBC) or under pressure (called Pressurised FBC) and at temperatures lower than those in PCF plants.

Integrated gasification combined cycle (IGCC) plants
IGCC plants are the newest of the three, with average thermal efficiency percentages in the 40s. At present, the use of IGCC for coal-based electricity production is limited with only four IGCC demonstration plants in operation globally, two located in the US, one in Spain and one in the Netherlands.

Coal by country
Top 5 producers of coal

<table>
<thead>
<tr>
<th>Country</th>
<th>% of total</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>39.4%</td>
<td>2,380.0</td>
</tr>
<tr>
<td>US</td>
<td>18.4%</td>
<td>567.3</td>
</tr>
<tr>
<td>India</td>
<td>6.8%</td>
<td>227.7</td>
</tr>
<tr>
<td>Australia</td>
<td>6.6%</td>
<td>227.7</td>
</tr>
<tr>
<td>Russia</td>
<td>4.7%</td>
<td>309.2</td>
</tr>
<tr>
<td>Other</td>
<td>23.2%</td>
<td>1,831.2</td>
</tr>
<tr>
<td>World</td>
<td>100.0%</td>
<td>6,195.1</td>
</tr>
</tbody>
</table>

Top 5 consumers of coal

<table>
<thead>
<tr>
<th>Country</th>
<th>% of total</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>38.6%</td>
<td>1,191.3</td>
</tr>
<tr>
<td>US</td>
<td>3.6%</td>
<td>112.5</td>
</tr>
<tr>
<td>India</td>
<td>3.9%</td>
<td>119.1</td>
</tr>
<tr>
<td>Australia</td>
<td>3.6%</td>
<td>112.5</td>
</tr>
<tr>
<td>Russia</td>
<td>3.6%</td>
<td>119.1</td>
</tr>
<tr>
<td>Other</td>
<td>28.5%</td>
<td>862.0</td>
</tr>
<tr>
<td>World</td>
<td>100.0%</td>
<td>3,690.7</td>
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</tbody>
</table>

Cost of Coal

Coal by country
Data collection
Determining global emissions from coal
For this analysis, emissions are primarily derived from existing data on a national level, for the largest coal-power producing countries. Emissions are separately assessed for power generation (plant-level) and for mining. As the aim of this study is to derive an estimate of global damages, it is not necessary to link exact flows of coal from mines to power plants. Instead, all emissions related to mining are assessed and approximately 91% of emissions related to global power generation (based on International Energy Agency data). It is important to note here that direct assessments of damage costs are unavailable for many countries around the world.

1. Primary emissions from coal combustion

Carbon dioxide (CO₂)
Based on global CO₂ emissions from power generation, a ranking of the top ten polluters was compiled - US, China, India, Japan, Germany, South Africa, Australia, Russia and Poland. These countries account for 85% of global coal combustion emissions. Together with emissions from other EU countries(1), 91% of global coal combustion emissions are covered. These are the countries that are assessed further for polluting emissions, referred to as “classical pollutants”(2) in this analysis (See Table II.1).

<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Emissions per year (kilotonnes)</th>
<th>PM2.5</th>
<th>CO₂</th>
<th>CH₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU</td>
<td>1.470,00 1.200,00 43,46</td>
<td>889.531,52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>People’s Republic of China</td>
<td>20.567,00 7.434,00 2.537,00</td>
<td>2.341.616,45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>10.068,00 3.595,00 87,07</td>
<td>1.973.502,42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>2.959,00 1.580,00</td>
<td>562.840,07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Russia</td>
<td>1.056,00 511,00 1.00</td>
<td>215.089,87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>23,00 21,00 11,00</td>
<td>212.647,68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Africa</td>
<td>1.177,00 526,00 51,00</td>
<td>199.634,09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>605,00 614,00 20,50</td>
<td>204.131,85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>37.925,00 15.481,00 2.751,03</td>
<td>6.598.993,94</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sulphur dioxide (SO₂)
The EU was assessed in the aggregate, with country-specific data derived for the US, China, India, Japan, South Africa, Australia, Russia (See Table II.1).

Nitrogen oxides (NOₓ)
The EU was assessed in the aggregate, with country-specific data derived for the US, China, India, Japan, South Africa, Australia, Russia (See Table II.1).

Particulate Matter (PM) 2.5
Data for China, Japan, South Africa and Russia are included (See Table II.1).

Methane (CH₄)
An aggregate global figure was generated, which was based on a generic emission factor of kg CH₄ generated per tonne of coal equivalent for methane emissions from coal storage at power stations (See Table II.1).

2. Emissions from coal mining
Global emissions related to mining were included in this analysis by relying on data from EcoInvent 2007. For several regions (East Asia, Eastern Europe, Western Europe and North America), average emission data was used. Pollutants assessed for economic analysis were CO₂, CH₄, PM 2.5, SO₂ and NOₓ (See Table II.2).

<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Emissions in kilotonnes</th>
<th>CO₂</th>
<th>CH₄</th>
<th>PM2.5</th>
<th>SO₂</th>
<th>NOₓ</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU</td>
<td>1355 209 4 44 29</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. Fatalities due to major accidents resulting from mining operations

Damage costs for mining accidents per unit of electricity generation have been previously calculated by Hirschberg et al., 2004 (See Table II.4). These figures include only accidents with more than five fatalities.

Results

Combustion

The analysis reveals that the approximate annual external costs of coal combustion, from the factors examined, is €355.75 billion.

Mining

The analysis reveals that the approximate annual external costs of coal mining, from the factors examined, is €673.87 million. The total value is significantly lower than those values related to coal combustion. However, it is worth noting that this analysis is incomplete. Factors such as ecosystem destruction, water and soil contamination etc were not included in this analysis due to the lack of reliable global data for these kinds of impacts.

Conclusion

Combining all damages listed above, CE Delft arrived at a total damage figure of roughly €360 billion. As discussed previously, this estimate does not include all possible emissions or all possible damages and should therefore be considered lower limits. This is true even for the factors considered in this analysis as not all the data was complete however the analysis still covered 91% of all emissions. For example, including emissions of particulate matter from the EU, US and India might have increased the estimate considerably. In the context of the parameters considered, this analysis shows that coal combustion in power plants accounts for the greatest level of damage. It is responsible for more than 99% of the total. Damage burden due to mining emissions is estimated to be about €674 million per year, and damage burden due to accidents – about €161 million per year.

Calculations

1. Damages attributable to climate change

Annual damage costs in the year 2007 for coal-derived CO₂ and CH₄ emissions were estimated for this analysis. This included emissions from both coal combustion and mining operations. A prevention cost assessment was performed by using a figure of €20/tonne. This value is based on the approximate prevention costs for CO₂, which were estimated by using the average price for carbon credits in the European Union Emission Trading Scheme (EU ETS). This was done in lieu of using figures for actual damage costs caused by CO₂ emissions as there is a great deal of uncertainty associated with such figures. It is important to note that CO₂ prevention costs will increase sharply. Some studies show the price may very well double in the next decade and as much as ten times by mid-century. While future costs for CO₂ prevention were not considered in the context of this analysis, a review of projected costs are provided in the table below. For CH₄, a factor of 23 was applied to reflect the impact of methane on global warming as compared to CO₂ and to estimate damage costs – €640/tonne. These values were then multiplied by the estimated annual emissions (See Table II.1) to calculate overall climate change-related damage costs attributable to these pollutants.

2. Human health impacts that result from air pollution

For non-CO₂ pollutants, or ‘classical pollutants’, a calculation of damage costs per tonne of emissions was performed. The basis of the damage costs for this calculation was the European Union - based NEEDS project (the last stage of the ExternE series), which has attached a monetary estimate to health impacts resulting from emissions of specific air pollutants. These estimates are available for emissions in 39 European and non-European countries and five sea regions. The results also include estimates of EU-average damage costs per tonne of specific pollutants.

The figures used in the NEEDS project were based primarily on willingness to pay (WTP) values from empirical studies on evaluation of mortality and morbidity effects. These figures were adjusted using purchasing power parity (PPP) factors and consequently, an average value weighted with respect to population was calculated to provide more representative figures for a global calculation. Without being able to run a full model including background pollution, dispersion pattern, population affected, meteorological conditions etc, only very rough estimates could be produced.

3. Fatalities due to major accidents resulting from mining operations

Damage costs for mining accidents per unit of electricity generation have been previously calculated by Hirschberg et al., 2004 (See Table II.4). These figures include only accidents with more than five fatalities.

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Table II.3 – Recommended values for GHG (Euro 2005 per tonne CO₂)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>2005</th>
<th>2010</th>
<th>2015</th>
<th>2025</th>
<th>2035</th>
<th>2045</th>
<th>2050</th>
<th>2055</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDC_NoEWP1</td>
<td>7</td>
<td>9</td>
<td>11</td>
<td>14</td>
<td>15</td>
<td>17</td>
<td>22</td>
<td>27</td>
</tr>
<tr>
<td>PP_MAC_Kyoto plus2</td>
<td>–</td>
<td>23.5</td>
<td>27</td>
<td>32</td>
<td>37</td>
<td>66</td>
<td>77</td>
<td>–</td>
</tr>
<tr>
<td>PP_MAC_2°3</td>
<td>–</td>
<td>23.5</td>
<td>31</td>
<td>51</td>
<td>87</td>
<td>146</td>
<td>198</td>
<td>–</td>
</tr>
</tbody>
</table>

1 Pure economic cost-benefit analysis with no equity weighting.
2 Use of agreed objectives (20% reduction of greenhouse gases by 2020).
3 Ambitious coal of 2 degree centigrade increase as compared to pre-industrial levels.

Source: NEEDS, 2008

Table II.4 – External damages of accidents in the coal power chain (Euro per MWh)

<table>
<thead>
<tr>
<th></th>
<th>Occupational</th>
<th>Public</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>0.061</td>
<td>0.061</td>
<td></td>
</tr>
<tr>
<td>OECD</td>
<td>0.0034</td>
<td>0.000061</td>
<td>0.003</td>
</tr>
<tr>
<td>Non-OECD (other)</td>
<td>0.032</td>
<td>0.000035</td>
<td>0.032</td>
</tr>
</tbody>
</table>
Figure based on the following calculation: In 2004, total CO2 emissions from fossil fuel combustion were 261.8 Gt CO2-eq. Coal was responsible for 41% of those emissions or 107.0 Gt CO2-eq. It is projected that emissions from fossil fuel combustion will increase to 404.8 Gt CO2-eq in 2030 under a business-as-usual scenario. Coal is estimated to be responsible 43% of these emissions or 17,372 Gt CO2-eq. Hence, a 60% increase in CO2 emissions from coal between 2004 and 2030. These figures have been sourced from page 110 and 290, Figure 4.25 of: IPCC, 2007: Climate Change 2007: Mitigation of Climate Change, 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, 851 pp.

ibid.


Colombia completed the privatization of its coal sector in 2004 with the closing of Mineralco, the former state-owned coal company. The largest coal producer in the country is the Carbones del Cerrejón consortium.

Chomsky, A. et al. 2007. The People Behind Colombian Coal, Casa Editorial Pisanca Cali’s (CIP), Colombia.

According to estimates from the Colombian government, the country’s coal production could reach 102 million short tonnes (Mmt) by 2010 (see www.eia.doe.gov/oiaf/ieo/cabs/Colombia/Coal.html).

See www.colombiagovernment.org/colombia128.htm.


ibid.

Interview with Javier Diorio Fuentes Elijio, Governor of Nariño, Tumaco, Colombia, 25 May 2008.

ibid.

ibid.

In 1982, the National Government granted 1,195 hectares for the development of infrastructure, such as the port, the railway, the airport, terminals etc.

Interview with José Julio Pérez, Albacra, Colombia, 28 May 2008.

Interview with Emilio Pérez, former Tabaco resident, Albacra, Colombia, 28 May 2008.


Interview with William Palmezano, the president of the Chanciata neighbourhood council, Chanciata, Colombia. 27 May 2008.

Unscientific mining: Mining without any technical know-how and equipment

Interview with Gayatri Devi, coal gatherer, India. 22 August 2008.

Interview with Dr Raji Agawal, practicing doctor in Jharia, India. 23 August 2008.

Interview with Sharit, resident of Lothia (coal fire area), India. 21 August 2008.

Interview with TK Lahiry, Technical Director, Bharat Coal Limited, India. 23 August 2008.

Sand mining: Open coal pits are exposed to the atmosphere resulting in spontaneous combustion. These pits need to be filled with non-flammable material such as sand once the coal has been extracted to avoid fires.

Interview with Ashok Agawal, president of Jharia Bachao Sangharsh Samiti – a local resistance body currently fighting BCCL’s plans in the Supreme Court, India. 21 August 2008.


ibid.

Interview with A. Ali Suleika, health expert of the city subdivision Respubliek.Verbovoo (Russian board performing supervision in sanitary sphere), Personal Compilation, Russia. 8 August 2008.

ibid.

Interview with Takumu Sato, Ainiyatulla, former miner. Russia. 8 August 2008.

ibid.

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Greenpeace is an independent global campaigning organisation that acts to change attitudes and behaviour, to protect and conserve the environment and to promote peace.

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