

## UNDERGROUND COAL GASIFICATION

The second set of allegedly clean coal technologies refer to the underground gasification of coal instead of direct extraction. This technique yields a synthesis gas from partially burning coal underground. Wells are drilled to access the coal seam and extract the gas, and to inject steam and oxygen or air for the combustion process.

The combustion process results in immensely high carbon emissions, including emissions of methane, which has 23 times the warming potential of CO<sub>2</sub>, and is hence only considered a clean coal technology in combination with CCS. However, experts estimate that the nature of the technology would allow only a maximum of 50% of the emissions to be captured through CCS, drastically reducing its potential to lower emissions.<sup>9</sup> On the other hand, underground coal gasification could make previously uneconomic coal reserves attractive for exploitation – drilling wells is cheaper than operating a coal mine - and thus increase the total amount of viable coal reserves by 300-400%.

Even with a partial use of CCS underground coal gasification is a massive threat to the climate.

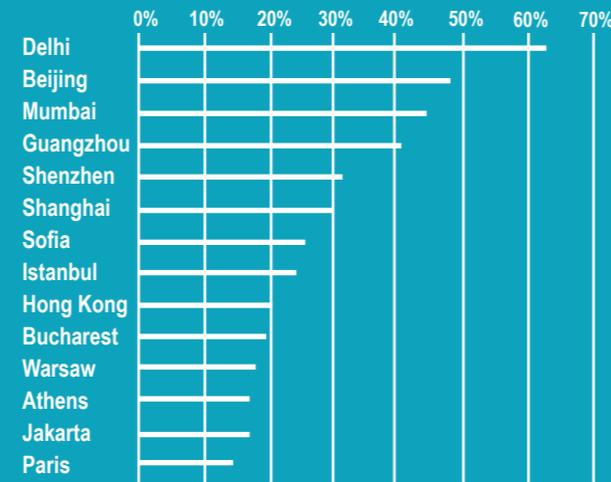
## HEALTH IMPACTS FROM BURNING COAL

Burning coal not only releases greenhouse gases but also a number of hazardous air pollutants, among them sulphur dioxide, nitrogen oxides, polycyclic aromatic hydrocarbons, particulate matter, and dioxins. They are released in huge quantities and can travel up to several hundred kilometres from the source. Because particles are extremely small (PM<sub>2.5</sub> have a diameter smaller than 2.5 micrometres), they can penetrate the lung tissue and enter the blood stream. They cause chronic diseases such as bronchitis, emphysema, lung cancer, atherosclerosis, heart attack and stroke.<sup>1</sup> Indoor smoke from household coal burning as well as outdoor air pollution have been classified as a human carcinogen by the WHO.<sup>2</sup>

Coal also contains trace elements such as mercury, cadmium, lead, arsenic, and radioisotopes. Coal-fired power plants are recognized as the second most important source for mercury emissions worldwide,<sup>3</sup> a heavy metal that is known for its irreversible damage to children's brains and cognitive development.

Some of these pollutants can be filtered out through deploying desulphurization equipment, electrostatic particle filters, and scrubbers at the power plant. These technologies are proven and economically viable technologies that can to a point address industrial pollution from coal. On the other hand, renewable energy technologies like wind power or solar produce no such pollution and are always the better alternative for human health.<sup>4</sup>

Increase in lung cancer risk from particulate pollution



Burning coal contributes to the high levels of air pollution and increases the risk of lung cancer in major urban centres

Source: PM<sub>2.5</sub> data from WHO OAP database, concentration-risk relationship from WHO Global Burden of Disease Study 2010<sup>5</sup>

## STATE-OF-THE-ART COAL – INCOMPATIBLE AND UNFLEXIBLE

The most modern coal power plants are able to increase their thermal efficiency to about 43-46% for lignite and hard coal, respectively, which is still way below the 60% thermal efficiency of a gas-fired station. The greatest efficiency potential is realized when a power plant supplies heat and electricity at the same time, called combined heat and power, or co-generation. But the business model of most operators does not make use of this option, which would require a smaller plant size and a location close to a population or industrial centre. Because large electricity-only plants are often located far away from the point of consumption, further losses of electricity in the transmission network can aggravate the poor energy balance of coal. For example in Bulgaria the transmission losses can reach up to 50%. Coal-fired power stations are not a suitable option for a modern, decentralized energy system that increases access to energy.

## RESISTING COAL

Explorations for new mines, coal power plants and transport infrastructure trigger the resistance of local communities. National and international solidarity movements have sprung up in support of these local struggles. More and more people realize that coal will always remain a dirty form of energy and that coal reserves have to stay in the ground in order to prevent dangerous climate change - as 'clean coal' technologies do not provide any real solutions.

All references can be found in the web version.

### CONTACT

Cough4coal campaign  
facebook.com/cough4coal  
Email: info@cough4coal.org



# CLEAN COAL? THERE IS NO SUCH THING

<sup>1</sup> The unpaid Health Bill: How coal power plants make us sick, HEAL (2013). [http://www.env-health.org/IMG/pdf/heal\\_report\\_the\\_unpaid\\_health\\_bill\\_-\\_how\\_coal\\_power\\_plants\\_make\\_us\\_sick\\_final.pdf](http://www.env-health.org/IMG/pdf/heal_report_the_unpaid_health_bill_-_how_coal_power_plants_make_us_sick_final.pdf)

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<sup>10</sup> Harvard Medical School Center For Health and the Global Environment (2011): Mining Coal, Mounting Costs: the Life Cycle Consequences of Coal. <http://chge.med.harvard.edu/sites/default/files/resources/MiningCoalMountingCosts.pdf>

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## INTRO

Air pollution levels in Beijing and other major Chinese cities have been making headlines, when millions of people were confined to their homes for several days to avoid the most drastic impacts on their health. For the longest time now the world believed that China would forever continue to build its infamous 'one new coal-fired power station per week'. China, however, is starting to rethink its course on coal: In September 2013 the Chinese government announced a cap on coal consumption in three economically important provinces. Cities like Beijing or Shanghai are introducing coal phase-out plans to protect their citizens' health. That is what is needed: Only by limiting its use and quickly phasing-out coal will we avoid the impacts on our health, on local environments and the planet's climate. Clean coal is a myth.

## EXTRACTION OF COAL – DANGEROUS AND DESTRUCTIVE

Coal surface mining, which can cover up to 100 square kilometres, leaves behind destroyed landscapes. It also lowers the water table in surrounding areas, thus damaging local ecosystems and agricultural land. Humungous volumes of coal and soil are moved every day, which blankets surrounding communities with dust particles and endangers the health of residents.<sup>10</sup> Mining coal is especially dangerous for the health of miners, who frequently suffer from pneumoconiosis (black lung disease), lung cancer, and other chronic diseases.<sup>11</sup> The operation of coal mines is prone to accidents. Mine collapses, landslides and land subsidence cost many lives every year and cause massive damage to infrastructure. These risks remain even after the closure of the mine. Through coal mining the mineral pyrite (iron sulphide) comes in contact with water and air and forms sulphuric acid. As water drains from the mine the acid drainage, filled with heavy metals and carcinogenic substances like benzene, moves into waterways. This process is known as acid mine drainage and persists even once mining operations have ceased. South Africa alone has hundreds

of abandoned coal mines, which are the biggest threat to the country's limited water resources.<sup>12</sup> Coal mining also generates huge quantities of solid and liquid waste, the latter originating from coal washing. Using anywhere from 75 to 150 litres of water per ton of coal, coal washing separates out non-combustible components in a sludge contaminated with heavy metals and organic carcinogens, also known as slurry.<sup>13</sup> Coal slurry is stored in large impoundments, which can seep or break down and constitute a massive risk for local communities and the environment. Mountain top-removal is probably the most destructive form of coal mining. The tops of mountains are literally blown off to reach coal reserves below. The rubble together with mining wastes is deposited in valleys and streams close by, destroying forests and rivers and poisoning communities downstream. Mountain top-removal so far has damaged nearly 2,000 miles of streams and threatens to destroy 1.4 million acres of mountain tops and forests by 2020.<sup>14</sup>

No matter how clean the industry claims the combustion process to be, the extraction and transport of coal from the mine will always bring a whole series of detrimental environmental and health impacts.

## CCS – EMPTY WORDS AND A FALSE PROMISE

Carbon capture and storage (CCS) technologies are offered most frequently as a pathway for 'cleaning up coal'. The underlying idea of capturing CO<sub>2</sub> before it is released to the atmosphere, and then storing it underground in geological formations, could be realized through different technologies - none of which has been demonstrated at the full scale of a commercially operating plant.<sup>6</sup> CCS technologies are simply too expensive and to date remain an empty promise. It is highly uncertain when CCS will be ready on a commercial scale. The promise of CCS thus cannot be used as an excuse to build additional coal-fired power plants, which in the meanwhile will cause unabated greenhouse gas emissions. Even if CCS became economically viable in the near future, the technology comes with a huge energy penalty, increasing the amount of coal required for running the plant by 20-30%.<sup>7</sup> Furthermore, CCS brings a range of new environmental and health risks. And a CCS plant would still emit the 'classic' air pollutants linked to health damage from coal burning.<sup>8</sup>

## JEOPARDIZING THE CLIMATE

Coal is the most emissions-intensive of all fossil fuels. The construction of each new coal-fired power plant locks in millions of tons of additional CO<sub>2</sub> emissions annually over 40 years, the average lifespan of a plant. The world cannot afford to build more coal-fired power stations and instead has to quickly phase out the burning of coal. In fact, to stay below the government set limit of 2°C of global temperature rise, only one fifth of proven reserves of fossil fuels can be burned.<sup>15</sup>

Providing assistance to secure the livelihoods of local communities in coal-mining regions is key to ensure a just transition to a coal-free future.



### Lungs

- Inflammation, oxidative stress
- Accelerated progression and exacerbation of COPD
- Increased respiratory symptoms
- Increased lung cancer risk
- Reduced lung function

### Brain

- Increased stroke risk

### Heart

- Altered cardiac autonomic function
- Oxidative stress
- Heart arrhythmia
- Increased risk of ischaemic heart attack

### Blood

- Altered rheology
- Increased coagulability
- Translocated particles
- Peripheral thrombosis
- Reduced oxygen saturation

### Vasculature

- Atherosclerosis, accelerated progression and destabilisation of plaques
- Endothelial dysfunction
- Vasoconstriction and hypertension

How inhalation of coal smoke may affect our health

Source: slightly adapted from "The Unpaid Health Bill: How coal power plants make you sick" by HEAL, 2013