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Clean Coal and The Two Faces of China's Coal Industry □□□□クリーンコールと中国石炭業の両面性

Andrew DeWit, Jonathan Watts

Clean Coal and The Two Faces of China's Coal Industry

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We present two perspectives on coal, alternative energy, and the future of China's industrialization in light of claims that its salvation lies in clean coal. Can advanced techniques for reducing carbon emissions in coal usher in the new wave of industrialization in China or elsewhere? Or is it new green technologies such as wind and solar power that will spearhead the next industrial revolution and transform the prospects for industry and the environment in the coming decades?

The Mirage of Clean Coal and the Technological Alternatives

Andrew DeWit

Why is it that many environmental experts emphasize that there is no such thing as clean coal? Certainly there are far-reaching efforts to develop "carbon-capture and sequestration" technologies to extract as much carbon dioxide as possible from the flue gases emitted by coal combustion. The captured carbon is then concentrated and can be used in various products such as making bricks or algae-derived biofuels. And it can be injected into depleting oil wells as part of enhanced recovery. Alternatively, it can be simply sequestered by pumping it into depleted oil wells, salt domes and other long-term disposal sites. There are various test plants in operation already. One oil well in Canada, the Weyburn project in southeastern Saskatchewan, already uses carbon dioxide derived from a coal gasification plant in North Dakota as an injection gas for tertiary extraction. That means that the CO2 is injected into the old well in order to push the remaining oil in the reservoir rock towards the drill holes so as to extract as much of the remaining resource as possible. These kinds of tertiary extraction techniques are deployed when gas pressures inside the reservoir rock have declined to such an extent that the oil does not flow naturally towards the well holes drilled to extract it. Other uses of carbon gases include a recent test plant in China wherein extracted carbon dioxide is used to feed algae that in turn produces a biofuel that is virtually indistinguishable from oil-derived gasoline and other products. The protein component of the algae can also be used as animal feed.

In Jonathan Watts' article on the "Two Faces of China's Coal Industry," we see that coal liquefaction is being touted as a means to put a clean face on the industry. But this is hardly new. Between 1934 and 1945, the Germans relied heavily on coal liquefaction to make fuel. The Japanese had a similar, albeit much smaller, production effort. And the internationally ostracized South African government of the apartheid years refined these processes. Indeed, South Africa still gets 30% of its transport fuel from coal liquefaction. The newer technologies can indeed deliver much cleaner liquid fuel at a significantly lower cost than in past processes, but the raw material remains coal.

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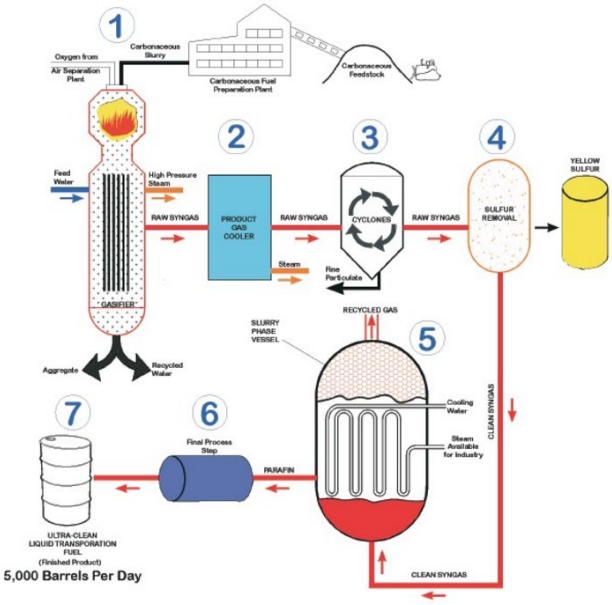

Coal liquefication process

Given the scale of the coal industry and the extent of the global reliance on coal for producing electricity as well as in other industrial processes, we will hear a great deal more about clean coal over the coming years. The industry and its allies are desperate to offer clean coal as a means of staying viable even as the world shifts towards more sustainable energy production and industrial processes. Some people appear to honestly believe that coal can be cleaned up, allowing us to continue using trillions of dollars in sunk costs represented by coal-fired power plants (aptly described as "death factories" by NASA's James Hansen). And some environmentally conscious individuals and organizations also understand that, at this point in time, there is political utility in stressing a role for clean coal. As governments move towards emphasizing sustainability via mandating a range of clean energy alternatives, including clean coal among the options helps limit the opposition from coal's huge corporate actors, unions and affiliated lobbyists.

But what must never be forgotten is that coal consumption does not only produce carbon dioxide. Burning coal releases massive amounts of mercury and other pollutants into the environment. Clean coal technology in power production is not going to remove these pollutants. Theoretically of course, it is possible to develop all kinds of apparatuses to remove these pollutants from the emission stream of coal combustion. But the more one removes pollutants and particulates from the emission stream, the more costly is coal-fired power per kilowatt hour. Coal's only strong points are that it is cheap, is already a major source of power, and there are plentiful reserves outside the OPEC countries. Raise its per kilowatt-hour cost, and it loses its main advantage to the truly clean energy sources, notably wind and solar, that are already at or close to grid parity (equivalent per kilowatt-hour generation cost) with it.

China coal-fueled steel production at Benxi

Moreover, the more one tries to clean up the emissions from coal combustion, the more coal one has to burn in order to produce the desired level of electricity output. This sad fact is true of the clean coal technology designed to remove only the carbon dioxide. Most estimates suggest that clean coal technology designed to capture carbon dioxide will require 25% to 40% of the produced energy to run the emissions-collecting apparatus. That means that at least 25% more coal will have to be consumed to produce the desired level of electrical output at coal-fired electrical generating stations. Aside

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from raising coal-fired power's per-kilowatt cost, that extra combustion is a big problem because, for one thing, the increased consumption of coal required by this process implies an increase in emissions of other poisonous substances. Recent research by the US National Academies of Science (see "Hidden Cost of Energy") on the damage already caused by burning coal suggests that the annual cost of this pollution exceeds USD 60 billion. And note that this staggering sum does not include damage from greenhouse gases and a host of emissions such as mercury, not to mention the land-use costs, and so on.

And in China, where 80% of energy is generated by coal, Chinese economists have assessed the damage at a startling USD 250 billion per year, or over 7% of Chinese GDP (link).

But that is not all. Imagine for example that we have some fanciful flood of technological advances that allow the consumption of coal without any emission whatsoever of carbon dioxide, mercury, sulfur dioxide and other pollutants that damage human health as well as exacerbate global warming. Even with these technologies we still require coal mining. And there, as the man said, is the rub. The production of coal causes enormous environmental damage as well as damage to human health. Subsurface mining remains dangerous to workers (e.g., black lung disease and high accident rates) as well as the environment, due to subsidence of land surfaces, release of methane through mining, and "acid rock drainage" from wastes. Moreover, one of the most common means of mining coal is through such extraordinarily destructive processes as removing entire mountaintops (link). The topsoil removed is called "overburden," wasteful earth that sits on top of the desired coal deposit. This overburden is generally dumped in valleys, further flattening the landscape. Hence, even before processing, transporting and burning the coal, its production visits massive destruction on the natural environment simply in terms of how it is altered in visual as well as ecological terms. But in addition, through acid rock drainage, the dumped materials of overburden and so forth release pollutants into rivers and the groundwater of nearby communities. Research by such respected organizations as Physicians for Social Responsibility (see their "Coal's Assault on Human Health") and others has shown that these upstream production processes, along with the combustion that follows, are extraordinarily damaging to human health.

So much for clean coal. The more one tries to contain the pollutants emitted by the combustion of coal, the greater the energy required to extract them and thus the more coal that is required to power the process. Upstream mining activities would therefore have to increase. In spite of the "clean fuel" claims of the liquefaction lobby, that is clearly not a sustainable kind of energy economy. Rather, clean coal and its derivative claims are the desperate strategies of an industry going into eclipse.

The Two Faces of China's Giant Coal Industry [Chinese language text available]

Jonathan Watts

Jonathan Watts reports from Ordos, Inner Mongolia, on a project whose proponents claim could eventually clean up the planet's fastest growing source of greenhouse gases. (Link)

The world's newest carbon citadel rises up between the blasted deserts of Inner Mongolia and the coal-black lands of Shaanxi province.

Ordos is a city that few outside China know. But the future of global emissions, and global warming looks increasingly more likely to be

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set in industrial powerhouses like this than in the negotiating halls of Copenhagen.

While the world's countries struggle to reach a treaty to defeat climate change, Chinese miners and scientists here are ramping up production and finding new ways to burn and bury carbon that will shape the policies of the world's biggest polluting nation.

Ordos is the new face of coal in China. It is home to the world's biggest coal company and an industrial-scale experiment to turn coal into diesel that could create a major new source of greenhouse gases. At the same time, it hosts the planet's most efficient mine and one of China's biggest carbon capture and storage projects, which buries the gases blamed for global warming.

What to do about China's emissions will be high on the agenda when China's president, Hu Jintao, meets Barack Obama on November 16. The summit brings together the two countries that together account for 40% of the world's greenhouse gases— most of which derives from this dirtiest of fossil fuels.

China is the world's biggest coal producer, the US is second.

China is trying to use science to clean up and expand coal production, which is good news for the local environment but potentially disastrous for the planet's climate. Both trends are apparent at Ordos. The discovery of extensive coal and gas deposits has turned this arid, northern outpost into a boom town. The local economy has grown eightfold over the past five years, while the population has swollen almost 20 per cent.

The past and future of coal are apparent at the district's southern border. On one side of the Huojitu river is the traditional mining region of Shaanxi province. Dirty, inefficient and dangerous, this is the face of Chinese coal that the outside world has grown used to.

At the small Bandingliang colliery, the pit has been dug so far into the hillside that truck drivers take 30 minutes to reach the coalface, fill up and return with their load. The tunnels are filled with exhaust emissions, coal dust and the roar of blasting.

"We drill holes," said Zhao Zhaoguo, a migrant from Henan province on his way down the shaft. "We stuff explosive inside, then a detonator. We set it off, and then, 'voom' – there's a big bang."

Such techniques have made China's mines the deadliest and most inefficient in the world, But they are changing.

Prompted by President Hu Jintao's drive for "scientific development", the government is on a drive to reduce waste, improve safety and boost productivity. Many small private collieries in the area have been shut down. Managers at Bandingliang say they have been given a choice of modernisation or closure. Next door, work is under way on a new mine that will have new equipment and more than twice the production capacity.

The technology is becoming more and more advanced," said Zhao. "In the future it will be fully electrified and mechanised. All we will have to do is press a button, and the coal will just come up by itself," said Zhao.

That vision is closest to coming true just a few kilometres away in Inner Mongolia, now the number one region for coal production in China. Heavy industry has followed the fuel. That trend and the low population density have given Inner Mongolia the highest per capita carbon dioxide emissions in China.

While the country's average is just a fifth of that of the US, in this area the 16 tonnes per person per year are almost twice the level in the UK.

But much of the industry here is more modern,

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efficient and "clean" than that of China's old rustbelt cities. Shenhua, the world's biggest coal company, runs several mega-mines in the region, the most advanced of which is the fully automated Shangwan pit, which produces more than 1m tonnes of coal a month with just 300 workers. On the outside at least, the state-owned company's pit resembles a garden more than a mine.

The Communist party mine secretary, Wang Tianliang, is proud of its efficiency and safety. "In this mechanised working face, this single shaft and single face ranks No 1 in China ... in the world we are No 1," he says. "In more than 3,000 days of operation, we have not had a deadly accident."

We drive 10 kilometres in a comfortable minibus to the pit face, 355 metres below the surface. The tunnel is wider and cleaner than the London Underground. There are just a handful of miners at our destination. They work with remote control devices that change the direction, position and speed of a German-made cutting machine that slices back and forth along a 300-metre-wide coal face. Giant Hydraulic supports keep the tunnel stable until the cutters have moved on. This hydraulic system is 100 per cent made in China," says Wang proudly.

New technology like this has boosted the nation's annual coal production to 2.2 billion tonnes. The Shangwan mine plans to almost double its output by 2015. In the control room, Wang shows me a bank of computers that run the operation displayed on a wall of CCTV images. One screen tracks the position of every worker in the mine. Another shows the rail depot, where a long line of carriages is filled automatically from conveyors at the rate of a tonne a second.

Before being loaded the coal is broken, filtered and scrubbed. The station is one of 17 washing and loading centres owned by the company. Here too, the story is one of expansion. According to the depot's deputy manager, Yuan Jun, the capacity has increased sixfold since 2002. The Carriages from Shangwan – each containing 60 to 80 tonnes of coal – are hauled off by powerful engines towards other mines, where more cargo is added. At peak times, snakes of 200-carriage trains pass every 10 minutes on single rails through northern China, en route to ports and major power plants on the wealthy eastern seaboard.

At the end of the line, the way coal is burned is changing too. Dirty old steel factories are being upgraded or relocated. To reduce smog, the low chimneys of small thermal power generators are being replaced by the towering smokestacks of more efficient "supercritical" plants. Although China is notoriously building one new coal-fired plant each week, most of them are more efficient than similar facilities in the UK. They are also better equipped to remove sulphur dioxide and other noxious gases.

But almost none of them remove carbon dioxide. The result is that local air pollution is finally easing in many places but emissions of greenhouse gases into the planet's atmosphere are increasing.

The pattern could change again, but not necessarily for the better. Beijing's leaders acknowledge the need to tackle climate change, but their priority is energy security. With oil prices high, China's policymakers are hedging their bets by investing in one of the world's most controversial fuels: coal diesel.

Shenhua is once again at the forefront of development. Last year, the company launched a pilot that uses an advanced technique on a scale never seen before in the world. In its first 12 months, the experimental liquefaction facility in Ordos expects to produce more than a million tonnes of vehicle fuel.

Coal-to-liquid technology has a long history. It was developed in Nazi Germany and enhanced

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by apartheid-era South Africa to get around fuel embargoes. Japan, the US and several other nations also launched small-scale trials after the oil price shock of the early 1970s. Most experiments were abandoned due to environmental and cost concerns.

But China has launched two major coal-to-liquid projects. One, in Ningxia, is a tie-up with SASOL that uses the South African firm's gasification methods. *The Guardian* is the first western media organisation to visit the other facility, in Ordos, which pioneers a direct liquefaction technique that "cracks" carbon with hydrogen extracted from water to produce clear diesel.

In the future, Shenhua hopes to expand production fivefold, largely using coal from the nearby Shangwan mine. The main driver is cost. Shu Geping, the chief engineer at the plant, says the price of liquid coal is competitive when the cost of oil is over $40 a barrel. In the future, as production increases and the technology is improved, it will become even cheaper.

Environmental concerns will weigh against these economic benefits. On the surface, the plant is impressively clean. There is no smell and in the glow of an Inner Mongolian sunset, white and pink smoke billows from its pipes.

But for each tonne of the liquid, six and a half tonnes of water must be piped from an aquifer more than 70 kilometres away and more than three tonnes of carbon dioxide are released into the air. These are major concerns for a country that is already desperately short of water and increasingly criticised as the world's biggest emitter of greenhouse gases.

Government researchers have been cautious about adopting this technology nationwide because liquid coal results in 50% to 100% more emissions than a comparable amount of oil.

The prospect of millions of petrol tanks being filled with such a fuel has alarmed environmentalist groups. "Developing this technology on a big scale will lock China up even further in its unsustainable reliance on coal, which is the biggest cause of climate change," said Yang Ailun, of Greenpeace.

Last year, the government blocked several new proposals for coal liquefaction facilities. But this may be to ensure the monopoly of the state firm. According to Shu, Shenhua plans to build another facility near Xinjiang's largely unexploited coal deposits. In the long term strategic concerns may ensure a future for liquefaction.

"To make the most of our energy strengths, producing oil from coal is of great strategic significance," he said. "I've read that if the output of coal-to-liquid plants could reach 50 million tonnes a year, then China's energy problems would be solved."

Shu insists his new facility can be good for the environment because it is equipped to capture and condense carbon dioxide for possible storage. Next year, the facility will begin one of China's most ambitious carbon capture and sequestration research programmes. In a US-backed project, it will store 100,000 tonnes of carbon dioxide annually in a nearby saline aquifer.

Its small beer compared to the 3 million tonnes of emissions from the plant, but a successful pilot project could pave the way for a wider scale adoption of the technology that many believe is of global importance. Ahead of Barack Obama's visit to Beijing this week, two US groups - the Natural Resources Defense Council and Asia Society - issued reports urging the two governments to promote carbon capture and sequestration projects in China.

Beijing's policymakers are doubtful. They believe dumping carbon underground is expensive and risky for local environments. But

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under foreign pressure, they have identified more than 100 sites for potential storage.

Ordos will lead the way, but it remains to be seen whether its scientists will be as successful with carbon storage as they have been with coal liquefaction.

Additional reporting by Cui Zheng

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Andrew DeWit is Professor of the Political Economy of Public Finance, Rikkyo University and an Asia-Pacific Journal coordinator. With Kaneko Masaru, he is the coauthor of Global Financial Crisis *published by Iwanami in 2008. He wrote this article for The Asia-Pacific Journal.*

Jonathan Watts is the environment correspondent for the Guardian.

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