

# KING COAL



Coal supplies 70 percent of China's energy needs, and is responsible for much of its pollution. Despite a huge buildup of alternative sources, coal production is surging and consumption is growing even faster.

# CHINA TRIES TO GIVE OLD KING COAL A MERRIER SOUL

By David Stanway and Fayen Wong  
FUXIN, China, Jan 11, 2011

Near the entrance of what was once Asia's biggest open-cast coal mine, Fan Chunming smiles as he points to a scale model of a manicured park with playgrounds, forests and streams -- an Arcadian vision that will be built in the depths of the pit.

"Construction will begin at the end of 2012 and that's what the mine will look like in about 10 years," said Fan, an urbane Chinese opera enthusiast, who is one of the officials entrusted with transforming the dismal site in Fuxin in northeastern China's Liaoning province into a national tourist attraction.

*China produces around a third of world coal supplies, but is responsible for about 80 percent of global mining fatalities. Illegal mining operations account for almost 70 percent of the country's fatalities*

Right now, the Haizhou coalmine, a freezing wilderness of winter mist and smog, couldn't look more different. Trucks heave in and out of the mine and thick smoke billows from its depths, coating the area in a sulphurous fug that hugs the surrounding slopes. The taste in the air is like spent matches.

Yet this is still a considerable improvement. "Ten years ago you'd come here to the side of the mine and you'd be coughing and spitting, and the spit would instantly be black," Fan said.

To reduce the pollution, flame retardant chemicals have been scattered over the smouldering remnants of



A miner waits to transport wagons loaded with sawdust in an underground coal mine in Xiaoyi, Shanxi province on June 27, 2010. REUTERS/Stringer

the mine, but fires will continue to spread sulphur, mercury and other toxins into the city air until they are finally extinguished in 2012. More than 60 percent of Fuxin's workforce once had jobs in the coal industry, but as its mines deplete, the city has had to tackle crippling unemployment, life-threatening pollution and catastrophic land subsidence.

Fuxin is a case study of the challenges China faces now and in the future, with king coal reigning over China's energy industry.

"Fuxin is a manifestation of problems that occur all over the old mining areas in China and are particularly prevalent in the northeast," said David Creedy, a veteran mining specialist who now works in Beijing with the British carbon project developers, Sindicatum.

"Fuxin is maybe the worst example

but there are lots of other historic, environmental problems that need to be handled," said Creedy, a former World Bank consultant.

Coal has left many of China's cities sinking and choking, its water supplies contaminated and a large section of its workforce suffering from chronic health problems. Fuxin's mine fires are nothing compared to those a century old that continue to burn in the northwest, polluting the air. Floods and explosions also make China's mines the deadliest in the world.

Despite talk of limiting production and tougher environmental standards, coal output is surging and China is spending heavily on new exploration projects. While investment in renewable energy is set to hit record levels, coal will fuel most of the country's economy for the foreseeable future and policymakers are

## TIMELINE OF CHINA'S LONG LOVE AFFAIR WITH COAL

Scholars say China first began burning coal for heat, cooking and smelting steel during the Han dynasty (beginning in 206 BC), but archaeological evidence from the far northwestern region of Xinjiang suggests it could have been even earlier.



figuring out how to make better use of it.

Coal has supplied more than 70 percent of China's energy for the past 50 years and consumption has increased around 10 percent a year since 2000. Routine disruptions in supplies regularly wreak havoc on the country's economy – power cuts hit large parts of China last month after freezing weather slowed coal deliveries, and worse is expected in January if temperatures plunge.

*Coal has supplied more than 70 percent of China's energy for the past 50 years and consumption has increased around 10 percent a year since 2000*

The U.S. Energy Information Administration predicted China will need to add 736 gigawatts of coal-fired capacity by 2035 to meet the requirements of economic growth and replace retired plants.

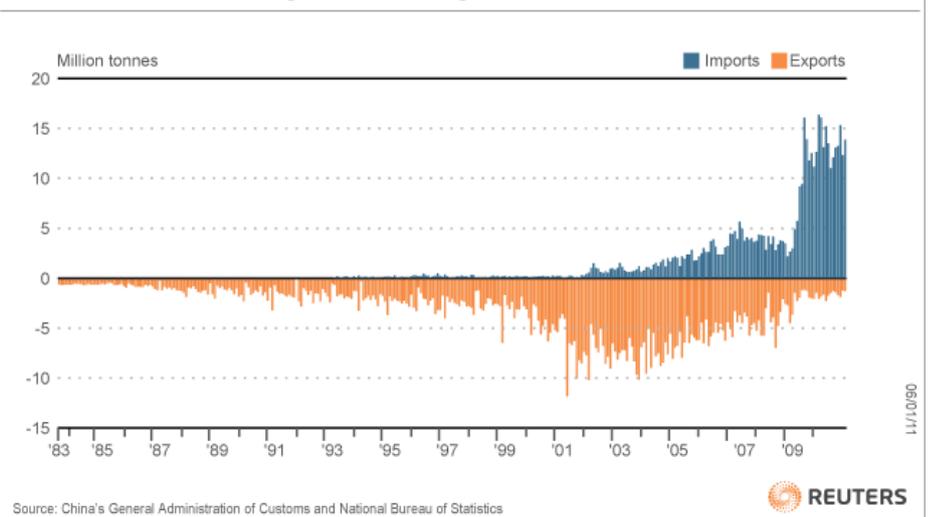
With each gigawatt of coal-fired generation requiring some 2.9 million tonnes of coal per year, those forecasts mean China would not only require massive investment in new plants but also an additional 2.13 billion tonnes a year of coal – total output last year was an estimated 3.2 billion. That would be a 60 percent jump in coal usage, ruining Beijing's plans to reduce coal's share of total generation to 70 percent by 2020 from 80 percent now.

"We don't have a lot of gas. Nor we do have a lot of oil. The only resource that is cheap and we have in abundance is coal, so our economy will have to rely on coal for a long time to come," said Ren Guangxi, President of Hangzhou Haoyang Energy Co Ltd.

## SINKING CITY

The Haizhou open-cast coalmine began operations in 1953 and supplied half of Fuxin's coal requirements in the decades that followed, feeding a huge Soviet-built power plant that dominates

## China coal imports/exports



the city's low-lying, ramshackle skyline. With miners digging ever deeper for dwindling supplies, the mine was finally declared bankrupt in 2005.

Satellite photographs of the Haizhou site show a massive crater resembling nothing so much as an asteroid hit. Five decades of intensive excavation left an abyss 4 km wide (2.4 miles) and 300 metres deep, along with a legacy of pollution and land subsidence the local

government is only beginning to address.

The foundations of the city were literally undermined. Around 100 square km of the city, with 27,000 buildings and around 78,000 residents, was on the verge of caving in, earning Fuxin the title of "sinking city". While a catastrophic landslide has been averted, much work needs to be done to shore up the mine's embankments, said Li Zhao, an official with the local land and resources bureau.



Miners take a break as a mine fire smoulders in the distance at the Haizhou opencast coalmine in Fuxin, Liaoning province on December 3, 2010. REUTERS/David Stanway

**1895:** Treaty of Shimonoseki, signed by China after losing a war with Japan, is the first of a number of "unequal treaties" with foreign powers giving overseas enterprises the rights to develop Chinese coal mines. The first mines are used to supply the fleets of foreign navies.



"We are still trying to solve the problem. We have to sink big supports into the earth, 10-20 metres deep, and it is a difficult process," Li said.

With consumption cuts not yet an option, China aims to burn coal without causing that sort of devastation in Fuxin and other major producing regions. But as older mines like Haizhou reach the end of their lives, production has inevitably moved elsewhere -- the Fuxin Mining Group has already invested in a mine in neighbouring Inner Mongolia -- and the curse of king coal spreads wider.

Other coal-producing provinces such as Liaoning, Heilongjiang, Shandong and Hubei have faced declining production despite efforts to dig deeper underground. As a result, many of these provinces have had to bring in coal from elsewhere in recent years.

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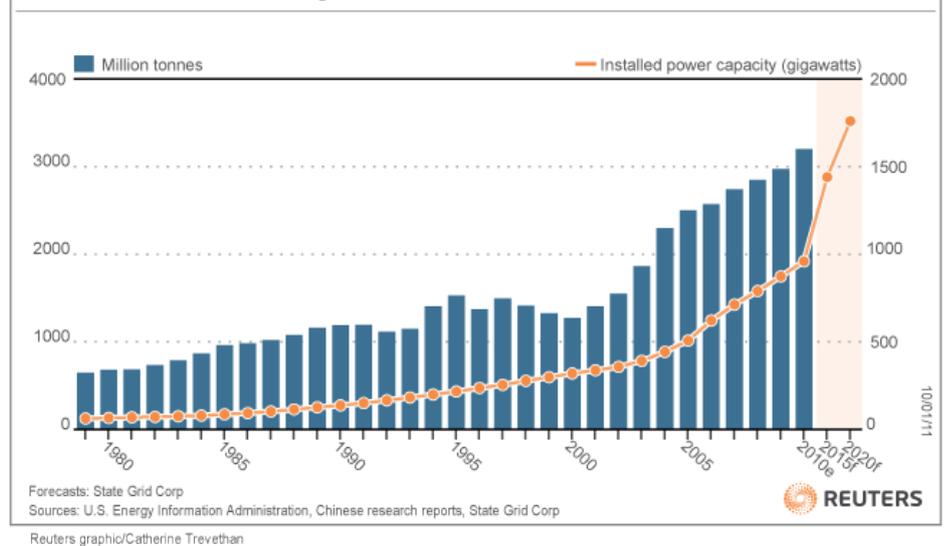
Developed cities and provinces such as Beijing, Shanghai, Jiangsu and Guangdong have shut down their own mines, but their coal consumption continues to rise. That has shifted the burden of production to other regions such as Shanxi, Shaanxi and Shandong.

"Provinces in the east have evolved from coal exporters to importers, and growth of coal production is concentrated in two western provinces: Inner Mongolia and Shanxi," said Citigroup's resources analyst Scarlett Chen.

As production moves north and west, the strain on China's transportation infrastructure has also increased, and the developed east and southern coasts have been forced to rely more on imports, something unthinkable a decade ago.

China has relied on its own coal production since the revolution in 1949. Back then, Beijing had no foreign currency and was under an international embargo. It had no choice but to depend on its own coal reserves to fuel growth.

## China coal output - 1979 - 2010



Big discoveries of crude oil in the northeast helped restrain coal demand for a while, but total output still reached around 618 million tonnes in 1978, behind only the United States and the Soviet Union. Then came China's "reform and opening up" period, and demand exploded.

Chinese government analysts expect annual coal demand to reach at least 4 billion tonnes by 2020, 25 percent higher than 2009, even after taking into account unprecedented levels of investment in nuclear, wind, solar, and hydro that the country is likely to see over the period.

### GREY LAUNDRY

On the road into Linfen in the coal heartland of Shanxi province, cars seem to disappear into the dense smog. Midday feels like dusk, with the city shrouded in a murky haze and the sun squinting through a thick curtain of smog. Local workers and residents emerge like ghosts from the gloom.

"You can still smell the soot in the air but believe me, it is now a lot better than before," said Eric Zhang, a Canadian returning to his home town to visit his parents. "White laundry used to turn grey before drying and it was especially bad in winter because

every home would be burning coal for heating."

Linfen has topped China's pollution charts since 2006, despite a clean-up campaign launched that year. Hundreds of small mines and factories have been shut, backyard boilers have been demolished and gas heating has been introduced to more than 85 percent of the city's population, said Yang Zhaofen, director of the city's Environmental Protection Bureau.

Coal trucks, a major source of dust, have been barred from travelling within a kilometre of the city's boundaries, and overloading is penalised.

*China will need an additional 2.13 billion tonnes a year of coal by 2035 – total output last year was an estimated 3.2 billion. That would be a 60 percent jump in coal usage*

The mines still open are subject to tougher environmental standards and fitted with industrial waste water treatment systems, said a manager at one of the privately-owned coal mines in Linfen, who was only willing to identify himself by his surname, Li.

Yet coal lies everywhere, piled in back alleys and sold in burnable cubes or balls

**1931:** Japan invades and occupies northeast China, seizing the region's coal mines and steel mills. After expanding along China's eastern coast, Japan eventually takes control of other major coal producing regions.





An old steam train passes through the bankrupt Haizhou opencast coalmine as smoke billows from chimneys in Fuxin, Liaoning province on December 3, 2010. REUTERS/David Stanway

mixed with soil.

Efforts to reverse damage caused by decades of over-mining are slow for the farmers in Linfen, a city of 4 million people once known as “the fruit and flower town” of Shanxi, before it was dubbed the world’s most polluted city.

Meng Zhilu, a 51-year-old farmer living in Kang village near the valley, said their wheat and barley harvests have shrunk over the years and their cotton field is constantly shrouded in grey dust.

“The environment may have improved, but the overall situation remains depressing. We are still covered in coal ash after working in the cotton fields for a day,” he said, fixing his gaze on a nearby coke plant.

Collieries destroy arable land and grazing pastures, erode topsoil and cause air and water pollution. The country’s most pressing environmental problems -- acid rain, smog, lung diseases, water contamination and the filthy layer of black dust that settles on many villages -- can all be traced to coal.

According to a World Bank report in

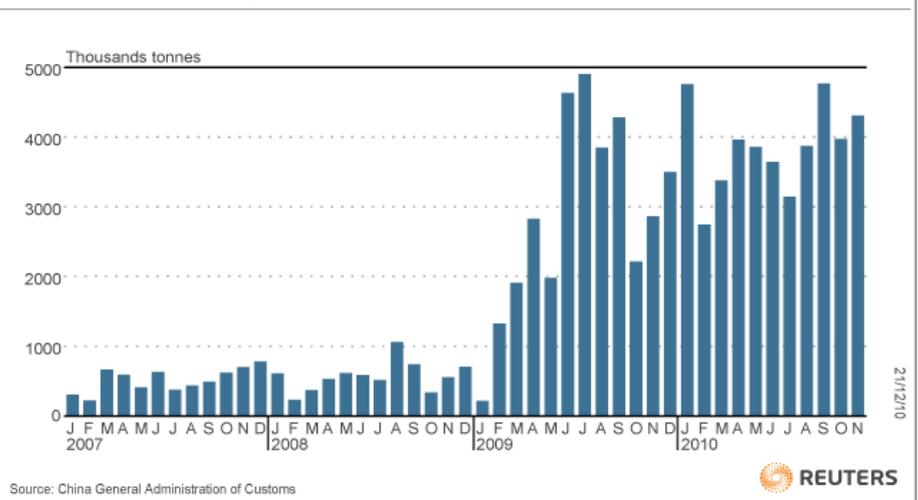
2007, 16 of the world’s 20 most polluted cities are in China.

Apart from its long-term effects on the environment, mining is also a brutal and perilous profession, and China’s chaotic coal sector has long been the most accident-prone of all. China produces around a third of world coal supplies,

but is responsible for about 80 percent of global mining fatalities. Illegal mining operations account for almost 70 percent of the country’s fatalities. China has been cracking down on them, while lifting safety standards at licensed mines.

China is also forcing mines to consolidate, aiming to create major

### China coking coal imports



**1949:** Red Army led by Communist Party chairman Mao Zedong takes control of Beijing. With China under an international trade embargo, the new government looks to coal to develop its economy, which has been crippled by a decade of Japanese occupation followed by civil war.



mining firms with the working capital to install and run safety equipment, a move that would also reduce accidents caused by different companies operating too close to each other and weakening mine walls.

Official statistics show the death rate per million tonnes of coal produced stood at 2.631 last year, a considerable improvement on 2002, when it reached a peak of 6.995.

### END OF CHEAP COAL

Experts say improving safety and environmental standards for the coal industry can only raise production costs, which have doubled to more than \$43 a tonne in the last five years. Transportation costs to move the fuel from the north to the south, which can make up as much as 60 percent of the final delivery price, have also jumped.

Moreover, the government is expected

to soon introduce a coal resource tax of 3-5 percent on coal miners, which along with an appreciating renminbi, could also push up prices.

Rising costs have in turn pushed up domestic thermal coal prices. Spot prices at Qinhuangdao, China's top coal port, have risen from around \$50 a tonne in 2005 to more than \$120. Spot prices across the world have soared, with the benchmark Australian globalCOAL Newcastle index reaching a 2010 high of \$123.50 at the end of December. As Chinese imports rise, analysts at Standard Chartered are expecting global thermal coal prices to rise by 14-20 percent in 2011.

*According to a World Bank report, 16 of the world's 20 most polluted cities are in China*

The drive for cleaner and low-carbon coal will inevitably push costs up even further.

Overseas producers and traders alike are betting the efforts to curb pollution and consolidate mines will make imports competitive, opening an arbitrage for coal to sail in from as far away as Colombia and the United States.

"The global coal industry has undergone a massive transformation because of China's demand and the import appetite can only grow bigger in the long term," said Mark Pervan, chief resource analyst at the Australia and New Zealand Bank.

As shallow-lying resources become depleted, miners are burrowing as deep as 1,500 metres in search of coal. Some experts predict China's coal reserves could actually run out.



A worker unloads coal at a storage site along a railway station in Shenyang, Liaoning province on April 13, 2010. REUTERS/Sheng Li

**1958:** China plans to more than double coal capacity to 335 million tonnes within five years as part of its "Great Leap Forward" industrialisation programme, but the withdrawal of Soviet aid and a nationwide famine force Beijing to revise targets.





Workers unload coal at a storage site along a railway station in Hefei, Anhui province on April 13, 2010. REUTERS/Sheng li

"China accounts for around 14 percent of global coal reserves but its share of global coal consumption is already over triple that at 47 percent, which is unsustainable," Hong Kong-based brokerage CLSA Asia-Pacific Markets said in a report.

*Improving safety and environmental standards for the coal industry can only raise production costs, which have doubled to more than \$43 a tonne in the last five years*

According to state news agency Xinhua, Beijing is considering capping domestic coal output at an annual 3.6-3.8 billion tonnes in the 2011-2015 period. Analysts said the cap was unrealistic. "If demand is higher than the cap, then China is not going to start shutting down factories and turning off lights in cities. They are going to try to satiate that demand," said Sindicatum's Creedy.

At least in the short term, production could well exceed any proposed cap. "We expect coal output to be higher than that (3.6-3.8 billion). We are seeing

a lot of non-coal companies producing coal and they've never done that before," said Angello Chan, analyst with Bank of America Merrill Lynch.

But experts see China's production inevitably slowing down. Data from energy major BP Plc shows China can only maintain current rates of production for 38 years before its 114.5 billion tonnes of proven reserves are stripped bare. That compares with 245 years in the United States and 105 years in India.

China has already started to import large quantities of coal.

"As they import more and more, it is impacting on world coal prices, and if they suddenly want more, then the price is going to rocket. There will be a shortage of ships and they have a limited boat capacity," Creedy said.

## EFFICIENT INDUSTRY

Some suggest China's energy plight has been exaggerated. Economic growth -- and energy demand -- could slow. And a newly consolidated mine industry is expected to increase output.

"An expansion phase will naturally come after consolidation. When 8-10 large firms start to have at least 100

million tonnes of capacity per year, with massive economies of scale and sophisticated technology, it would be no sweat for them to ramp up output by at least 10 percent each year," said the chief of a private coal firm. "The central government may have aspirational output targets, but they eventually have little control over these mines because these mine bosses have powerful political backing from factional groups," he said. He declined to be identified as his firm is planning a listing.

*"The global coal industry has undergone a massive transformation because of China's demand and the import appetite can only grow bigger in the long term" -- Mark Pervan, chief resource analyst at the Australia and New Zealand Bank*

China's attempts to boost energy efficiency could also relieve pressure on coal supplies.

Thousands of small and inefficient industrial plants have already been shut down and the standards are likely to get

**1962:** Output reaches 220 million tonnes, almost half the level of 1960 when millions of farmers were forced to leave the countryside and go to work in mines, factories and steel mills instead.

**1966:** Output exceeds 300 million tonnes, but Mao's decision to launch the Great Proletarian Cultural Revolution soon disrupts Chinese industry and production slips back to 225 million tonnes the following year.



tougher in the coming years. As Beijing introduces new environmental taxes that will push up the price of coal even further, big consumers will have another incentive to cut back.

Paul Manley, Wood Mackenzie's coal analyst in China, said the country's coal production could soon return to normal growth levels once Beijing's consolidation drive comes to an end and is forecasting annual output to increase another 1.9 billion tonnes by 2020 to more than 5 billion tonnes a year.

China has spent heavily on new mines -- 320.7 billion yuan (\$50 billion) in fixed asset investment in the first 11 months of the year, up 22.7 percent compared to the same period of 2010, according to industry figures.

Extensive geological surveys in Inner Mongolia -- an autonomous region of 1.2 million square km accounting for 12 percent of China's total area -- may lead to more coalfield discoveries.

Massive investments in wind power will reduce the country's dependence on coal, while some believe China's rapidly developing solar power technology may well hold the key to long-term energy security in a country that has some of the world's biggest deserts.

### *Local officials remain open to the possibility of building a "coal mine disaster theme park" in the area*

Although solar power generation costs are now about 2-3 times higher than for coal in China, solar power could become as cheap as coal-fired power by around the middle of this decade, thanks to the sharp fall in the cost of photovoltaic cells used in solar panels, said Dylen Liu, a researcher at Pacific Epoch consultancy in Shanghai.

When it comes to supply shortfalls in the short term, however, some traders reckon the only quick fix is abolishing the 17 percent import tariff on coal.

"Clearly, the government should cut the import tariffs and allow foreign coal to compete on a level playing field. It is



A miner works at an underground coal mine in Xiaoyi county, Shanxi province on June 12, 2010. REUTERS/Stringer

also the most effective way to lower fuel costs for the state-owned power plants," said the head of a European coal trading firm.

### COAL THEME PARK

In Fuxin, the mines may be running dry but coal will continue to dominate the city's future. Outlying mines produce around 20 million tonnes of coal a year, and state power giant Datang Group is building a massive coal gasification plant in the city.

At the bankrupt Haizhou mine, more radical solutions are necessary. It employed 30,000 miners at its peak, but now only around 1,000 brave the fires to excavate the last remnants of coal. Production will cease at the end of 2012.

The city has lined up investors from Guangdong and Macau for a five-star hotel near the site, but plans to construct a golf course have been put on hold. Local officials remain open to the possibility of building a "coal mine

disaster theme park" in the area, where methane blasts could be simulated by bombarding guests with black ping-pong balls.

Premier Wen Jiabao, who visited the site in 2003, encouraged the rehabilitation project. Eating dumplings with miners during Chinese New Year celebrations, he urged the country to learn from the suffering and sacrifices of coal workers everywhere.

Chen Qi, head of the Fuxin tourist bureau, said private investment in the tourism and park projects was expected to reach about 4 billion yuan over the coming years, while the complete rehabilitation of the mine will cost more than 10 billion yuan.

The city also aims to become a wind power base, manufacturing blades and turbines as well as supplying electricity to the rest of Liaoning, a transformation almost as startling as turning its colliery into a tourist site. "The situation in Fuxin

**1978:** With annual coal output already at 618 million tonnes, third biggest in the world, China's experiment with capitalist reform is launched, allowing private enterprises to invest in the coal sector.

**1984:** China switches to "guidance planning" system, allowing coal mines to sell surpluses on the market after fulfilling mandatory production quotas. Policy leads to rapid expansion of private coal operations.



## CHINA'S SEARCH FOR "CLEAN COAL"

*China's plans for its massive coal sector in the next 10 years include introducing new "clean coal" technologies.*

### COAL TO LIQUIDS

Coal-to-liquids was once regarded as one of the most exciting technologies. Dozens of projects were launched as Beijing looked for alternatives to crude oil imports. China went cold on CTL in 2008, suspending most of the projects on concerns the technology was expensive and wasted too much water, especially in poor, arid regions.

Experts regard CTL as an emergency measure, and it is no coincidence the liquefaction technologies were developed by fuel-hungry Germany during the Second World War and embargo-hit South Africa during the apartheid era.

A CTL plant built by the state-owned coal giant Shenhua Group is expected to produce 11 million tonnes of oil products a year by 2020, up from less than 1 million tonnes this year, said the company's general manager for science and technology, Gu Dazhao.

Work was also allowed to continue on a project in arid Ningxia province, designed with South African energy giant Sasol, but it still has not been given the final go-ahead.

Other smaller projects are being built, and China is expected to have a total CTL capacity of 30 million tonnes by 2020, said Cao Liren, chief engineer of the China Synfuels Corp at a recent conference.

Apart from its excessive use of water, CTL also does nothing by itself to address a more pressing global concern -- carbon dioxide emissions. But CTL shows signs of making a comeback, especially if it can be combined with other technologies like carbon capture and storage.

### CARBON CAPTURE

The International Energy Agency says carbon capture and storage could provide as much as 18 percent of China's required CO2 reductions in the coming decades, but progress on the technology has so far been slow. It allows CO2 to be separated from the coal combustion process and stored in underground sites such as saline aquifers or depleted oil wells.

China's advantage is that it can drive the development of new technologies by forcing state-owned firms such as to build expensive demonstration projects, which Shenhua and Huaneng are doing.

Shenhua is building a carbon capture and storage facility alongside its CTL plant in Inner Mongolia, and will begin storing CO2 early in 2011. Officials have complained openly that both facilities are prohibitively expensive.

Representatives from Huaneng, China's biggest power generator, have also said CCS is very expensive, though it is going ahead with two pilot projects in Beijing and Shanghai.

Not only does CCS significantly increase costs, it also reduces the efficiency of a power plant, and for that reason, would require subsidies, or at the very least, a price on carbon.

CCS has received little tangible state backing so far as the government waits for possible support from rich nations under a global climate change protocol.

### INTEGRATED GASIFICATION COMBINED CYCLE

The "Greengen" project in the northern municipality of Tianjin is one of China's flagship pilot clean coal projects. It relies on a self-designed integrated gas combined cycle technology. Its first phase, which consists of a 250 megawatt power plant, is expected to begin generating electricity by the end of 2011.

The project, which will eventually include a large laboratory looking specifically at issues like CCS, is being led by state power giant Huaneng and counts Peabody among its investors,

Qi Chunsong, vice-president of the project, said IGCC was "an inevitable choice" for China but he conceded the economics were not attractive.

"It will never be commercial in the sense that it doesn't require preferential policies. If the government wants to give support to clean coal then it becomes an option and the economics start to work," he told Reuters.

### COALBED METHANE (CBM)

Harvesting the methane that builds up in China's notoriously gas-heavy coal mines has also become a key industry strategy. Collecting and using CBM would reduce the risk of mine explosions, create a new and cleaner energy source and prevent a greenhouse gas from entering the atmosphere.

China has more than 200 billion cubic metres of CBM reserves and expects to produce 2 bcm this year. Volumes are likely to rise steadily in the next decade. But the process is complex and production costs high.

### UNDERGROUND COAL GASIFICATION (UCG)

Technologies aimed at gasifying coal before it is mined have been in development for half a century. China has launched 16 demonstration projects, including one in collaboration with U.S. utility Duke Energy.

By eliminating the need to bring coal to the surface, UCG could improve safety and help boost China's coal recovery rates, experts say. But developers find it difficult to commercialise.

*Reporting by David Stanway  
Editing by Bill Tarrant*

**1997:** Small "township and village enterprises" account for 46% of total coal output, up from 17% in 1979, and safety and efficiency problems abound. Government responds with first nationwide crackdown on small mines.

**2005:** Explosion at Sunjiawan coalmine in Fuxin kills 214 miners, one of the worst disasters in years, prompting another crackdown on unsafe mines and government officials accused of profiting from them.





A coal-burning power station can be seen behind migrant workers as they carry their shovels on the construction site of a water canal being built in a dried-up river bed, located on the outskirts of Beijing on October 22, 2010. REUTERS/David Gray

disaster theme park” in the area, where methane blasts could be simulated by bombarding guests with black ping-pong balls.

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The city also aims to become a wind power base, manufacturing blades and turbines as well as supplying electricity to the rest of Liaoning, a transformation almost as startling as turning its colliery into a tourist site. “The situation in Fuxin is horrendous -- it is like going on the moon, and the scale of what needs to be done is frightening,” said Sindicatum’s Creedy, who visited the site.

Through the smoke and haze of the Haizhou mine, local officials in Fuxin look on the bright side.

“You’re probably surprised by what we have already done,” said Chen of the Fuxin tourist bureau, waving her hand at the city’s new museum housing

the model of the coalmine park near the entrance to the Haizhou mine. The spotless public square on which the museum stands displays a monument to the city’s sacrifices, along with three giant pieces of old Soviet-era machinery dragged from the pit.

“We are convinced that all these plans will come to fruition and in 10 years time this place will be completely transformed.”

(Editing by: Bill Tarrant)

For a Reuters graphic website on coal see: <http://bond.views.session.rservers.com/COAL/>

**2006:** New policies are introduced banning coal mines with production capacities lower than 30,000 tonnes a year.

**2009:** China becomes a net coal importer for the full year for the first time in its history. Total number of mines cut by 40 percent to 15,000 after long campaign to eliminate small players from the sector.

**2010:** Total output estimated to rise 8 percent to more than 3.2 billion tonnes, according to data from the China Coal Industry Association



**Cover photo:** A coal worker smiles after finishing his shift at a power plant in Shenyang, Liaoning province on November 4, 2010. REUTERS/Sheng Li

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