

SEPTEMBER 15, 2008
PRODUCERS

Cleaning Up Coal's Act

New projects offer the chance to tap inaccessible reserves, as well as limit the release of harmful gases

By [DAVID WINNING](#)

Article

Comments

BEIJING -- India and China are at the forefront of a new wave in clean-coal technology that has the potential to tap enormous and otherwise inaccessible coal reserves -- and to slow the speed of climate change.

The Asian giants are investigating large-scale commercial projects that would produce energy by burning the coal where it lies, deep below the Earth's surface. Building on pilot projects in the U.S. and elsewhere, the two countries are also looking at the possibility of capturing and permanently storing underground the gases produced, like carbon dioxide, which scientists believe cause global warming.

The Journal Report

See the complete [Energy](#) report.



The underlying technology is one pioneered by the Soviets during the 1930s, called underground coal gasification -- a way to tap energy from coal that was impossible or too costly to bring to the surface. A borehole is

drilled down to the coal seam, which is then ignited. Oxygen is forced down through the borehole to feed the combustion. Gases produced by the combustion are then forced out a second borehole to the surface, where they are harnessed to turn turbines or for the production of chemicals. A power plant in Uzbekistan has been using the process for nearly 50 years. But elsewhere the practice was largely abandoned as increasing reserves of oil and natural gas were discovered, providing a cheaper alternative.

New Life

Now, thanks to higher oil and gas prices, underground coal gasification has again become cost-competitive. Advances in the technology also make the practice more attractive. Tests in Europe in the late 1990s demonstrated it was possible to have greater control of deep drilling, to create larger cavities in the coal seam for the gases and to provide more efficient combustion. Also, while the process once was criticized for generating large quantities of hydrogen as a useless byproduct, hydrogen is now in demand as a feedstock for the chemical industry and shows potential as an alternative fuel for vehicles.

Experts say underground gasification could triple or quadruple recoverable coal reserves globally, offsetting declines in other energy reserves such as crude oil. China and India have the world's third- and fourth-largest coal reserves, respectively. The U.S. has the most, and Russia is No. 2, according to industry estimates. China is believed to have conducted more trials of the process than any other country over the past 10 years; one estimate counts at least 17 since 1991. A Chinese-built chemical plant in Inner Mongolia now uses the process to produce a diesel-fuel substitute, and the Chinese company that built the plant has plans for a much larger sister plant in China itself. India, meanwhile, plans to use underground gasification both to generate more power and to produce pesticides and chemicals.

Heavy use of coal already in rapidly developing countries like China and India has come at a price of worsening pollution, particularly from traditional coal-fired plants that aren't fitted with

equipment to strip out sulfur and capture emissions. Thus, underground gasification also presents an attractive alternative because it produces no sulfur oxide or nitrogen oxide, there are lower levels of mercury and particulates, and the ash stays underground. Experts say the technology is especially suitable for low-rank coals like lignites and sub-bituminous coal, which produce less heat when burned due to their high ash content, and are highly polluting.

"This has driven a lot of recent investigation in India where that is a major technological limitation to their coal development because their coal is 35% to 50% ash," says Julio Friedmann, leader of the carbon-management program at the Lawrence Livermore National Laboratory in Livermore, Calif.

Other countries such as the U.S., U.K., South Africa and Australia have all shown renewed interest in the process over the past decade. Eskom Holdings Ltd., the biggest power generator in South Africa, performed a trial at the Majuba coal field north of Johannesburg, which has reserves of 1.2 billion tons. U.S. and British energy companies are studying the possibility of using it in the Powder River Basin along the Wyoming-Montana border, the largest source of mined coal in the U.S. In Britain, officials hope the process will provide access to vast coal reserves under the North Sea.

Fire Down Below

Coal Wave: China and India are moving toward large-scale adoptions of a clean-coal technology -- underground coal gasification -- that burns hard-to-reach deposits deep underground, and holds promise for capturing and storing the resulting greenhouse gases.

Some Concerns: More testing is necessary to investigate the possibilities of underground water contamination and large cave-ins.

Moving Ahead: China is already using the technology at one plant and has plans for more. India is still forming its plans.

surrounding rock strata is sufficiently strong. Water contamination is avoidable, he says, if operators manage the pressure in the cavity properly. The risks of subsidence and contamination also generally decrease with depth, he says.

Underground coal gasification isn't the only "clean-coal" technology in the works. One of the most popular is a technique known as integrated gasification combined cycle system, or IGCC. IGCC plants bring the coal to the surface, where it is heated and turned into synthetic gas, which then turns a turbine to generate electricity. [Duke Energy Corp.](#) has won approval from state regulators for a \$2 billion IGCC plant in Indiana. [American Electric Power Co.](#) is pursuing IGCC projects in West Virginia and Ohio, and [NRG Energy Inc.](#) has proposed building a \$1.5 billion IGCC plant in upstate New York.

But because the above-ground process requires expensive gasification equipment -- and extraction of the coal -- it's considerably more expensive than the underground gasification process. [GasTech Inc.](#), a Casper, Wyo.-based gas-exploration company, says its studies show that capital costs of building an underground-gasification facility are 25% lower and its operating costs 50% lower than a comparable IGCC plant.

Carbon Capture

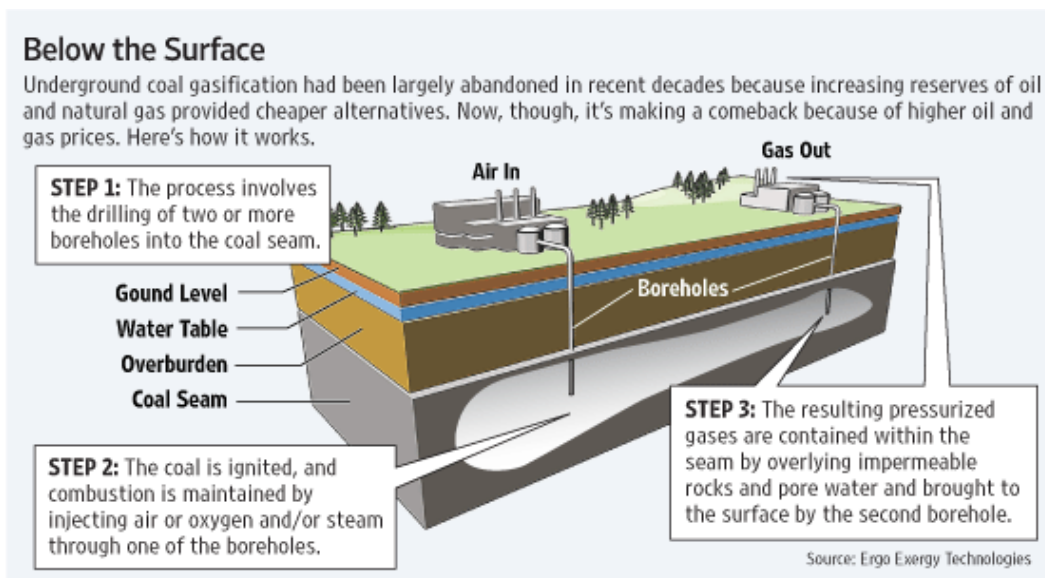
A large-scale project that includes carbon capture and sequestration, meanwhile, is still years away. The big hope is that carbon dioxide produced in the process can be pumped back into the void left by the combustion of the coal underground, and permanently sequestered from the atmosphere, helping to reduce the emission of greenhouse gases. But experts say more tests

Concerns Linger

Experts are still cautious about rolling out the process on a massive scale. There's some concern that it will contaminate underground water supplies, or cause serious incidents of subsidence, which involves land sinking into the cavities created when the coal seams are drilled and burned out.

Mr. Friedmann says the risk of subsidence is small if a good site is chosen and the

are needed before it can be proved that carbon dioxide can be permanently stored in the cavities created, and at an affordable cost. Indeed, carbon capture would likely make underground gasification more expensive.



China has about 30 projects in different phases of preparation that use underground coal gasification, says Ming Sung, a former vice-president of XinAo Holdings Ltd., a unit of the Chinese energy company ENN Group. Mr. Sung is now chief representative, Asia-Pacific, at the Clean Air Task Force, a Boston-based nonprofit advocacy group. So far, there is only one plant operating, a methanol plant in Inner Mongolia operated by ENN Group. But the company is drawing up plans for a similar plant in Liaoning province that will be 15 times larger, says Mr. Sung. The new plant will produce 300,000 metric tons of methanol a year, which will be converted into dimethyl ether, a substitute for diesel. A spokeswoman for ENN's XinAo unit says the plant is still in the preparation stage.

India, meanwhile, wants to use underground gasification to access an estimated 350 billion tons of coal discovered by state-run Oil & Natural Gas Corp. in the states of Gujarat and West Bengal. Some of the carbon dioxide produced could be pumped into underground oil reservoirs to boost recovery of heavy oil discovered in Gujarat. This is being done in an Energy Department-funded project straddling the U.S. and Canadian border. Dakota Gasification Co. is piping carbon dioxide from a coal-gasification plant in Beulah, N.D., to an oil field in Saskatchewan where it has helped increase the field's production, according to the Energy Department.

Last year, India compiled a 93-page status report on underground coal gasification that highlighted plans from many of the country's biggest companies, including Oil & Natural Gas, the conglomerate Reliance Industries Ltd. and state-run natural-gas distributor GAIL India Ltd. According to the report, GAIL envisages three commercial UCG-powered plants in operation by 2015. The company declined to comment.

Many companies say they want governments to provide incentives before they get involved. In its submission to the Indian government, for example, Reliance Industries said it wanted a similar fiscal regime to that provided to producers of coalbed methane because UCG "remains untested in India and has many inherent uncertainties." These incentives include a tax holiday for seven years and the freedom to use, sell and price any gas that is produced. A company spokesman declined to comment further.

—Mr. Winning is a news editor for Dow Jones Newswires in Beijing.

Write to David Winning at david.winning@dowjones.com