

OLD KING COAL COMES BACK

Actually, it never really left. In fact, as our energy demands grow, we'll be using more coal than ever. **BY JEREMY MAIN**

ON A FREEZING, PRISTINE DAY, WITH the Bighorn Mountains shining nearly 100 miles away across the Wyoming prairie, a huge dragline with an arm longer than a football field gulps 100 cubic yards of rock and soil by the mouthful to expose the underlying coal. Down below, near the face of an 80-foot-high coal seam, a massive shovel scoops up the black stuff and drops it into trucks capable of carrying up to 400 tons each. They rumble off to a nearby loading station where, night and day, mile-long trains snake around a double loop of tracks, slowing to load but never quite stopping, then set off across the country, hauling 15,000 tons of coal each. At 18 or more trains a day, that's more than a quarter-million tons of coal a day—out of a single mine.

This happens 365 days a year at Peabody Energy's North Antelope-Rochelle mine, the largest coal mine in the world. Last year the mine shipped 82 million tons of coal, or 8% of the coal used in the U.S. The mine lies in the heart of what miners like to call the Saudi Arabia of coal, the Powder River Basin in north-eastern Wyoming and southern Montana. The U.S. has an estimated 268 billion tons of recoverable coal in existing mines, amounting to two to three times as much energy in coal as Saudi Arabia has in oil—enough to last a couple of centuries or more. Nearly half of that coal is right here in the Powder River Basin. Montana has 75 billion tons, which has hardly been touched, and Wyoming 42 billion tons. That's only the coal in existing mines. If you consider total recoverable reserves, the U.S. has nearly 500 billion tons, so on that basis Illinois can become a major new player too, with reserves of 105 billion tons.

Cheap, abundant, and safe from international crises—Old King Coal is coming back. Actually, it never went away. We just didn't notice it much, except as a polluter. During the last half of the last century other sources of energy caught our attention—nuclear power, imported oil—and in the 1990s, we became enthusiastic about cheap, clean natural gas. So we didn't see that coal had a future. But it was there all the time, the largest single source of power generation in the U.S., providing just over half of our electricity. And our demand for electricity just keeps growing. Power production has increased steadily, by about 26% in the past ten years, and the Energy Information Administration predicts steady 1.8% growth annually to 2020.

This wealth of coal can't flow freely through the U.S. economy until some costly and difficult fixes are applied across the whole business of mining, transporting, and burning coal. Rail

transport is tight. Compared to bituminous coal from Appalachia, which now dominates the U.S. coal-power scene, the Powder River Basin's sub-bituminous coal has less sulfur but also less energy. Many power plants will need costly renovations before they can use the Western coal.

Most important, the growth of coal plants in the U.S. and the even faster growth in China and India will add billions of tons of carbon to the atmosphere, overwhelming any possible gain from the Kyoto treaty. Assuming that the output of carbon dioxide and other pollutants from power plants proves to be the primary cause of global warming, as is increasingly evident, then burning coal could become our most serious environmental threat. However, new technologies offer the possibility of completely, or almost completely, emission-free burning. The government is spending \$2 billion on clean-coal technology this decade. Corporate America is getting involved too. General Electric and Bechtel recently formed a partnership to build cleaner power plants.

The heads of two of the country's largest coal producers, Irl Engelhardt of Peabody Energy and Bret Clayton of Kennecott Energy, accept that coal needs to be cleaner. "We'll have to invest in technology to continue to make coal cleaner and cleaner," says Clayton. "The goal is near-zero emissions," says Engelhardt. They also urge the U.S. to try to keep a balanced mix of energy sources. But this will be difficult for now. Nobody is building new nuclear plants, and those built decades ago have started shutting down. Supplies of oil and gas are tightening, and prices have shot up.

Now the electric utilities are going back to coal. Natural gas costs three times what it did at the end of the 1990s, and instead of building gas-fired plants, as they did in the 1990s, utilities are planning coal-burning plants. Power industry consultant Robert McIlvaine counts about 100 new coal plants in the works in the U.S. Since most of these are still only projects, he believes many probably will never be built. Even so, dozens of new coal plants will go up in the next couple of decades. That's a lot of coal, a lot of electricity, and a lot of new pollutants.

The growth in coal production will have to come largely from the Powder River Basin. Eastern coal from Appalachia, which has powered American industry for more than two centuries, is starting to run short. The higher-quality Eastern coal has doubled in price in the past two years, from about \$30 a ton to \$60 or more. Meanwhile the price of Powder River Basin coal has remained remarkably steady for years at about \$6 a ton, with only

a small jog upward recently. It's not quite the bargain it seems, because the cost of transporting it a long way adds \$30 or so a ton to the price, and it has about one-third less energy, so power companies have to buy more of it. Still, compared with any other source of energy except sunshine, wind, and falling water, Western coal is cheap.

At Peabody's North Antelope mine you can see where the huge coal bed came to the surface, for the rocks are burned red by coal ignited centuries ago in prairie fires set ablaze by Native Americans and by nature. The coal seams stretch miles to the West but slant deeper into the earth, so more and more "overburden"—the soil and sandstone and clay above the coal—has to be moved aside before miners can reach the coal. When the overburden gets to be 500 feet thick, the coal may no longer be worth mining. But right now the Peabody draglines are moving 210 feet of overburden to get at a rich seam 80 feet thick, stretching far out west. In Appalachia, miners have to go deep underground to get at a seam only six to eight feet thick.

In this form of surface mining, the first step is to loosen the overburden with explosives. Then the huge draglines, which cost \$70 million each when new, move in to set the topsoil to one side and the rest of the overburden to another side. More explosives loosen the coal below. Then diesel shovels, with buckets big enough to fit two SUVs, pick up the loosened coal and drop it into those enormous trucks. The largest trucks cost \$3.3 million apiece; each of their tires, over 12 feet tall, costs \$30,000.

The trucks crawl like enormous beetles along wide dirt roads to loading stations, where they dump the coal into crushers. From the crushers it moves up conveyor belts into silos straddling the railway tracks. The double loop of tracks permits two trains to move through at a time if necessary. As each of the train's 100 or more cars moves under the silo, precisely 100 tons of coal drops into it. Once the train has its 15,000 tons, it rolls onward to a power plant hundreds or thousands of miles away.

At North Antelope and at Kennecott's nearby Cordero Rojo mine, which produces about half of North Antelope's 82 million tons a year, as well as at other mines in the basin, the same massive operation goes on all year round, 24 hours a day except when snow drifts block Route 59 north to Gillette, the "Energy Capital of America" (pop. 24,000). Fresh crews have to reach the mine every 12 hours.

In the final part of the operation, the dragline returns the overburden and topsoil to "approximately" the original contours of the prairie, as Wyoming law requires. Then the dragline waddles on huge pads to a new location at a speed of about six feet a minute. Wyoming's Department of Environmental Quality says that in the state as a whole, mining has torn up 110,580 acres of prairie, backfilled and graded 40,800 of those acres, and seeded 37,000 acres.

Environmentalists say that the coal companies sometimes skimp on buying the right prairie seeds and bushes, especially sagebrush. They also claim that the mining and the blasting spread dust and sometimes even poisonous fumes across the land. But on the whole they seem satisfied that the mines are relatively kind to the environment. "I think everyone will tell you they're doing a good job," says Harold Bergman, director of the Ruckelshaus Institute of the Environment and Natural Resources at the University of Wyoming. (Bergman will not say the same for another mining operation, the extraction of methane gas from some 12,000 small wells. Wyoming ranchers and environmentalists are incensed about the disruptions caused by drilling, traffic, power

lines, and noisy equipment spread over 6,000 square miles.)

The strong demand for Powder River Basin coal is beginning to put strains on the coal supply chain. It takes three months to get one of those huge tires the dump trucks use. The railroads, which also are coping with growth in ship-container traffic, are stressed. Some utilities report getting coal deliveries in the nick of time or not at all.

In 2004 the recovery from the recent recession caught the railroads by surprise. Arch Coal, which owns the huge Black Thunder mine in the basin, wrote in its second-quarter report last year, "Rail difficulties resulted in missed shipments in both East and West, including some of the company's highest-margin Eastern business." The company said the rail delays cost it \$8 million. The two railroads that serve the basin, Burlington Northern and Union Pacific, are beefing up. Union Pacific hired a record 5,000 workers to add to train crews last year, bought 700 locomotives, and ordered another 315.

Coal can also be transported, in a sense, along transmission lines. At some point it may even prove economical to build mine-mouth power plants in Wyoming and transmit the electricity long distances. Whether or not that happens, the national power grid needs strengthening. An invention by 3M, creator of Post-its and Scotch tape, may go a long way to doing just that: The company has come up with a transmission line that carries twice as much power as the wires used now, and in an emergency they can carry much more.

The new cable came about in the serendipitous way that things happen at 3M. The company was researching the use of ceramics in jet engines in the early 1990s and found that ceramic fibers and aluminum are compatible. Then Tracy Anderson, who now runs the power-line project, saw long transmission cables sagging across northern Minnesota lakes from one distant tower to another. Linking the research to the observation, 3M figured it could apply its jet-engine research to making a lighter high-performance cable. Conventional cable is made of aluminum wrapped around a steel cable. 3M's composite conductor, as it is dubbed, consists of heat-resistant zirconium-aluminum cable wrapped around a core of aluminum-oxide fibers. As conventional lines transmit electricity, they heat up and sag. If overloaded, they can sag into a tree or some other obstacle, which is what started the 2003 blackout that crippled the Northeast. The 3M cable withstands higher temperatures with less sagging and is stronger and lighter. While the average conductor may carry 800 to 1,000 amps, the 3M line handles 1,600 to 1,800 on average and has coped with five times as much as a conventional line.

The 3M cable has been tested successfully in short, one-mile segments, and now Excel Energy, a Twin Cities utility, is installing a ten-mile section through the suburbs on an existing right of way with the existing towers. A special advantage of the 3M product is that utilities don't need to battle for new rights of way, and they don't have to fight the NIMBY reaction or build new towers.

Despite its abundance, low price, and low sulfur, Powder River Basin coal creates problems for utilities that burn it. It contains chemicals that gum up boilers with lumps of black, rocklike slag. These lumps, which get up to the size of a VW Bug, reduce the efficiency of the plant. The slag may fall 60 to 80 feet from the upper reaches of the boiler and smash the floor of the furnace. More likely the slag will have to be attacked violently to remove it, sometimes even with small explosive charges or shotguns. The plant may be closed for days of cleaning.

Many existing plants can safely burn a mixture of 70% Western coal and 30% Eastern coal without getting slag problems, but if they go to 100% Western coal, which many are doing, then they will probably need new technology. Fuel-Tech N.V., a pollution-control company in Batavia, Ill., has developed a process to prevent slagging. The system squirts an atomized slurry of magnesium hydroxide and water into the boiler in exact doses, which changes the slag into a harmless, crumbly substance that can readily be removed.

Western Farmers' Electric Cooperative, an Oklahoma utility, was using 100% Western coal at its Hugo plant and as a result had to shut down twice a year for five or six days to attack the slag. The utility solved the problem two years ago by adopting Fuel-Tech's system, known as TIFI (for targeted in-furnace injection).

Robert Richard, vice president for fossil generation at DTE Energy, a major Michigan utility, is pleased with the Fuel-Tech process. DTE has converted two small stations and is adding two more. He regards the use of TIFI as a pilot, but results so far are good. The savings far exceed the cost of installing and running the system. New plants can be designed to handle Western coal without Fuel-Tech's help, but Fuel-Tech president Steven Argabright figures there are some 200 older boilers in the U.S. that need it. (The U.S. has roughly 1,000 coal-fired boilers at 411 plant sites.)

There are other new technologies in coal's future that will make it more efficient, cleaner, and more versatile. Some are already available, while others await pilot projects to prove their worth. Gasified coal can run cleaner plants, perhaps almost emission-free. Liquefied coal can run cars, as it has for years in South Africa.

Under the requirements of the 1970 Clean Air Act and its amendments, power plants have substantially reduced their emissions of particulates, sulfur, and nitrogen oxides. By installing scrubbers, they have cut sulfur-dioxide emissions, the main cause of acid rain, to half what they were in 1980.

But where do the plants stand with the big unknown—global warming? Carbon-dioxide emissions have been curbed only to the extent that the utilities have become more efficient and therefore burn less coal for the same output. Forget the Kyoto Accord. President Bush, whose Clear Skies Initiative calls for only voluntary constraints on carbon dioxide, brusquely rejected the treaty. And anyway, Kyoto aims for only a 5.2% reduction in carbon-dioxide emissions by 2010. So even if the U.S. had joined,

CO₂ emissions would still be going up rather than down. Developing countries are exempt from Kyoto, and the hundreds of plants that China and India plan to build—plus the plants the U.S. and others have in the works—will add billions of tons of carbon dioxide to the atmosphere.

Carbon dioxide can't be ignored, and coal is its primary producer. As Kennecott's Clayton says, "You can only address carbon by addressing coal." William Reilly, former EPA administrator and co-chairman of a bipartisan commission that issued an energy policy report last December, says, "Coal gasification, when combined with carbon sequestration, has the potential to revolutionize energy production."

He was referring to a technology called integrated gasification combined cycle, or IGCC. Today's natural-gas plants use a single cycle—after the natural gas burns, the resulting stream of hot exhaust turns a turbine that produces electricity. It's clean, but it's inefficient because all that hot gas then goes to waste. An IGCC plant captures the heat and uses it to create steam, which then produces more electricity—hence the name "combined cycle." Better still, IGCC plants can run on synthetic gas, or syngas, as it's called in the industry, which is made by partially oxidizing coal. Syngas burns cleaner than coal and makes it possible to remove the waste carbon dioxide. IGCC isn't economical yet on a vast scale. Nor does anyone really know what to do with all that "captured" carbon—billions of tons of it, once the plants are widespread. A possible solution is to bury it in old oil and coal fields, but that idea might run into the same opposition that nuclear waste has encountered.

Still, IGCC is coming. A sure sign that it has become a mainstream business became evident last year when General Electric bought ChevronTexaco's gasification operations and then went into partnership with Bechtel to commercialize IGCC technology. The partners had worked together on IGCC pilot plants, and now they are talking with Cinergy, a big Indiana utility, about building a 500- or 600-megawatt plant. But IGCC plants will not be ready before the end of the decade, and the technology that will make them carbon-free is still further off.

In the meantime, for the next ten or 20 years the world's growing power needs will be met by more coal-burning plants, certainly cleaner than the old ones, but not free of carbon emissions. Natural gas will generate a diminishing share of power. Other energy sources—hydrogen, fuel cells—may start to contribute, and nuclear power may well make a comeback. But coal will still be king for years to come. F

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THE NAM / FORTUNE MANUFACTURING INDEX

Accentuating the positive

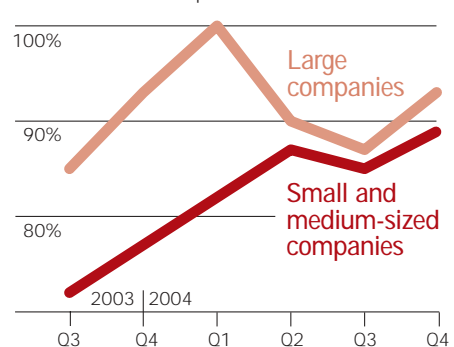
Manufacturers are feeling quite pleased with the economy's prospects. According to the latest survey of 409 companies conducted in March by the National Association of Manufacturers and FORTUNE, they think sales are going up and feel confident they'll be able to raise prices. Some 93% of the large manufacturers (those employing more than 1,000 workers) said they had a positive outlook, which is the second-highest level in the history of the survey. Small and medium-sized companies are almost as upbeat: 89% of them said they have a positive outlook, the hap-

piest that group has been since the first quarter of 1998.

And those circumstances will make it easier to hire some new people, maybe hand out some raises, and invest in a whole lot more capital equipment. Large companies said they would increase spending on equipment and software by 4.9% over the coming four quarters. That's a record high for our survey and nearly twice as fast as the 2.6% growth expectation in the 2003 fourth quarter. Smaller respondents expect their capital purchases to grow by 2.6%.

Outlook

Manufacturers with a positive business outlook



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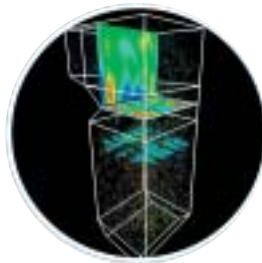


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