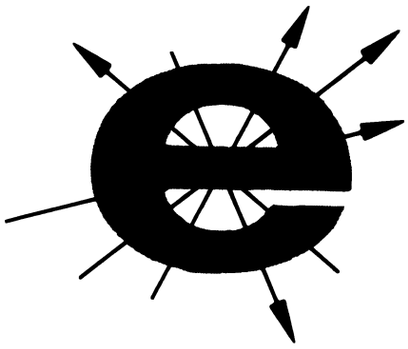
Coal: The stopgap fuel—maybe



This is the second article in a series on the energy crisis. After covering fuel shortages and temporary solutions, the series will discuss nuclear and solar sources as long-range remedies.

Bucyrus-Erie Co.

Strip mining shovel in Ohio dwarfs normal-sized bulldozer beneath.

by John H. Douglas

As oil and natural gas reserves dwindle and installation of nuclear power plants drags along, years behind schedule, the United States rapidly approaches a grave decision: whether to rely on unproven technology of solar and geothermal power, to continue using oil as the primary fuel source and have to import as much as 60 percent of it by 1985, or to return to the fuel that powered the industrial revolution and blackened the nation's cities for over a century—coal.

Increasingly, the technical planners of Government and the "smart money" investors of industry are choosing coal.

Some 15 to 20 percent of coal production and an unknown quantity of coal reserves now lie in the hands of oil companies. Traditionally, coal operators have tended to be small, intensely competitive outfits with slim profit margins and almost no investment capital. The nation's 5,000 coal mines are run by 4,000 separate concerns, and the handful of coal companies that have grown into major industries are just the ones now being bought up by oil companies, which do have the capital to fund the new coal age and find themselves running out of their traditional resources.

At the National Coal Association convention in Washington recently, an impressive group of Government officials dropped by to offer encouragement. "Until we develop technology sufficient to utilize yet untapped energy sources such as fusion, solar and geothermal energy," said Secretary of Interior Rogers Morton, "coal will be the keystone to meeting our long-term energy needs." Atomic Energy Commission Chairman Dixy Lee Ray told the convention that coal would be necessary to bring about further development of atomic energy. Her own commission now burns some 2 percent of the nation's coal, mostly to produce enriched uranium, and may soon use as much as 7 percent. "We know that some of you call some of us the 'nukes' and I won't divulge what some of us have called some of you," she joked, but "past rivalries have been overshadowed."

Speaking for the White House, Presidential consultant Charles DiBona hinted to the delegates that they could shortly expect more Government R&D funds to help meet environmental requirements. Environmental Protection Agency Acting Administrator Robert W. Fri said he believed pollution difficulties could be overcome and that coal, "the once and future king," would be restored to the monarchy.

Such enthusiasm stems from some straight forward considerations. Almost 80 percent of America's total fossil fuel resources—and an overwhelming 93 percent of global energy resources—lie in coal deposits. By the turn of the century, 87 percent of the world's oil reserves will have been exhausted, but only 2 percent of its coal. Yet the United States continues to take 79 percent of its energy from oil and natural gas and only 18 percent from coal. Coal production has dropped every year since 1967 as electric utilities increased their use of cleaner burning oil by 25-fold.

The trend cannot go on. Harnessing the inexhaustible sources of energy that can be considered the only real "solution" of the energy crisis will take until well into the 21st century, and coal appears to be the most practical stopgap fuel. Current projections show a rise in coal use in the United States from 569 million tons in 1971 to 1.4 billion tons by the turn of the century. But before such a changeover can take place, difficult problems must be overcome and unpleasant decisions made.

The first problem is that more coal will mean more strip mining, particularly in regions of the West where an estimated 25 billion tons of coal lie in deep seams just below the surface. Much of the land, spread over Colorado, Montana, Wyoming, Utah and New Mexico, is remote, rugged and untouched by man for any commercial use. No one will yet venture to predict what compromises can be reached to allow tapping this wealth and introducing auxiliary processing industries to the area. Citizens of Colorado recently voted in open referendum to prohibit the 1976 Winter Olympics in their state because of the possible en-

Before reclamation: Strip mined land is planted with pine and hardwood. Note bushy poplar tree near right.

National Coal Association

After reclamation: Nearly 24 years later, the landmark poplar is virtually obscured by new growth of forest.

vironmental damage, and they may well prove unsympathetic to developers planning to excavate huge tracts of their prairie. Large coal deposits lie on Indian reservations, including some on sacred land. Edwin Phelps, the blunt-spoken president of the Peabody Coal Co.—the nation's largest—told his colleagues in Washington that discussing coal holdings with the Indians was a "continuing frustration. . . . Negotiating with them can be—well, call it an interesting experience."

The same might be said for much of the history of the coal industry. Grimy, rugged, often dangerous, the mining and processing of coal has become the stuff of folklore. Deep beneath the ground miners constantly faced the hazards of cave-in, fire, explosion or the creeping death of asphyxiation. Coal fields often lay in remote areas where companies had to set up their own towns and where many a miner "owed his soul to the company store." Violence was common around the camps, and even years after leaving the mine, a man might develop pneumoconiosis—the dreaded "black lung" disease. Strip mining left great open scars across the rolling mountains of Appalachia and the acidic drainage from mines poisoned lakes and streams.

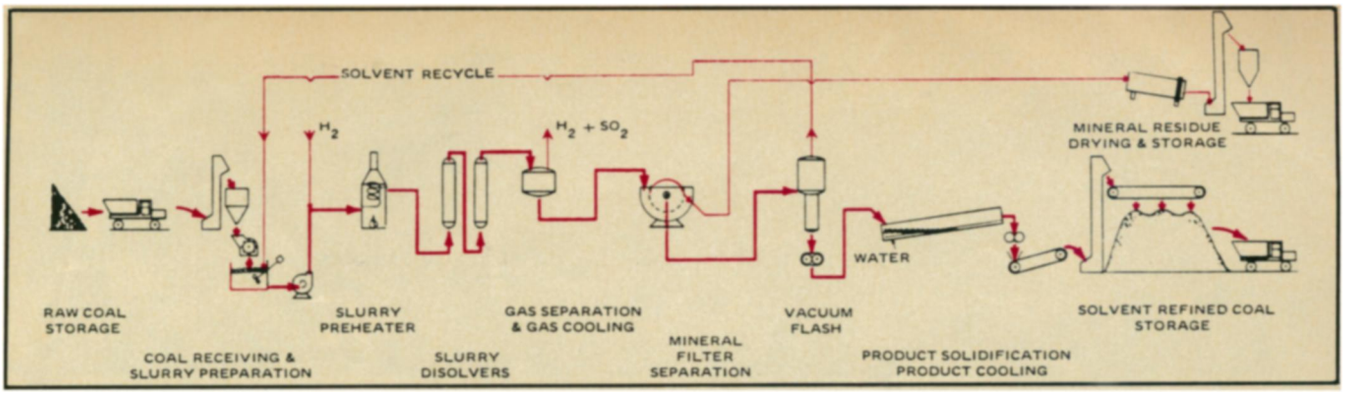
Technology and a measure of social conscience have brought some changes. Sensitive instruments check the miner's air supply, replacing canaries that were once taken into the shafts because of their greater sensitivity to lethal gases. Over 1,600 accidental mine deaths have occurred since 1966, and some 75,000 injuries, but the Federal Coal Mine Health and Safety Act of 1969 set new standards of mine maintenance and made employers responsible for the medical well-being of their workers. Strip mining is more often followed by attempts at reclamation. In 1971, 20,369 acres of strip-mined land in coal-dependent West Virginia were reclaimed, compared with 878 acres a decade earlier.

Faced with a multitude of widely varying state strip mining laws, the coal industry now officially supports Congressional efforts to establish a national mined-lands reclamation act. Ironically the Health and Safety Act may increase pressure to mine by stripping since the industry claims the law has resulted in a 15 percent drop in productivity and has already cost them a billion dollars through trying to meet its requirements.

Another argument used to justify strip mining is that coal fields are often only marginally suitable for agriculture anyway and that a carefully thought out plan of reclamation would actually increase the area's productivity through flattening hills and creating lakes. However, much debate still rages concerning the fate of various animals during the interruption of their habitat and the desirability of preserving the "original contour" of the terrain. This may be impossible in some areas, particularly in the new Western coal fields where hundred-foot-thick seams of coal are covered with only about 30 feet of soil.

The other great problem of reintroducing coal as a principal fuel is its dirtiness when burning. The poet Robert Burns once scratched on a sooty window near the coal burning Carron Iron Works of his native Scotland: *"We cam na here to view your warks/In hopes to be mair wise/But only, lest we gang to Hell/It may be nae surprise."* Improved technology should at least prevent things from getting as bad as all that again.

The great plumes of thick black smoke that belched from industrial chimneys of Burns' time can now be almost completely eliminated. Electrostatic precipitators have been in use for many years and the tiny particles of unburned carbon known as soot can be almost entirely removed. But a more insidious pollutant remains—the caustic sulfur dioxide gas that eats away at building facades and, presumably, human lungs. Standards set by the Environmental Protection Agency limit the emission of sulfur dioxide from new plants to 1.2 pounds per million Btu coal burned, which means the coal must contain no more than about 0.7 percent sulfur or the excess pollutant must be removed. Western coal could generally meet this standard



but Appalachian coal contains as much as five times too much sulfur and must be "scrubbed." EPA believes technology is now available to do the task; the coal industry, with 24 pilot-plant installations of scrubbing equipment, says it is not. As problems have mounted, much attention has shifted from trying to clean up the mess after coal is burned to trying to clean the coal itself.

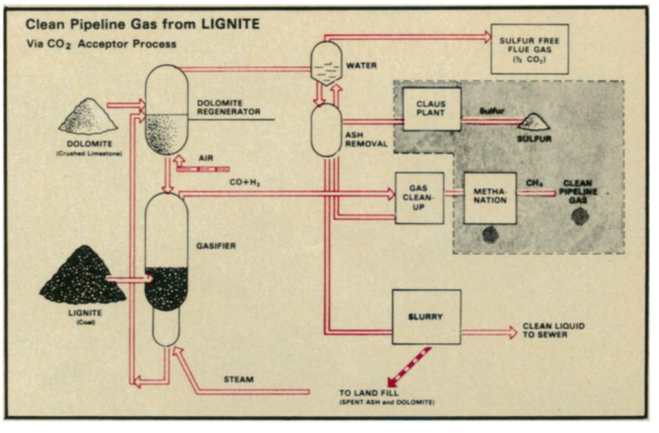
A promising new process that removes most of the sulfur and other impurities, leaving a uniform-quality, high-performance product, is called solvent refining. Coal is dissolved at high temperatures and pressure in a solvent containing a small amount of hydrogen. The undissolved sulfur is filtered off, the solvent is distilled away and recycled, and the molten mass of refined coal can either be piped to a waiting furnace or cooled into a shiny, brittle solid. By-products of the process include useful sulfur, benzene, toluene, xylene and a high-quality oil. The solvent-refined coal itself has a sulfur content as low as one-half the Federal requirement and an exceptionally good heating capacity of 16,000 Btu/lb.

Because of soaring transportation costs and the inaccessibility of Western coal deposits, transforming the coal to a low sulfur, high heating value gas is becoming more attractive. Coal gasification is an old idea, having fueled the "gaslight era," and new technology is concentrating on producing a gas with twice the heating capacity as the old "town gas," and at a lower cost. The basic reactions occuring in gasification are essentially the same in the various methods that have been developed. The systems differ mostly in the way of feeding coal into a reactor and in the reactor design. First, a low-quality gas with much carbon monoxide (CO) and hydrogen (H_2) is produced by the reaction of air and steam with the coal. Dolomite (crushed limestone) may be added to react with the sulfur. The raw gas is cleaned of impurities, such as hydrogen sulfide, then the carbon monoxide and hydrogen are combined to form methane (CH_4), as a pipeline-quality gas.

An intriguing variation of this process is being tried by the AEC at the Lawrence Livermore Laboratory. By creating pockets in coal seams, using conventional explosives, then pumping a hot steam-oxygen mixture into the cavity, engineers hope to produce raw CO-H_2 gas at the coal-field site. If successful, this process could eliminate the necessity of mining the coal all together.

R. M. Jimeson and R. R. Maddocks

Above: Solvent refined coal process. Right: One type of coal gasification process.



National Coal Association

Other refining processes under consideration include coal liquefaction and fluid-bed burning. The main attraction of converting coal to a liquid is that the resulting product could be introduced directly into the pipes that now carry oil and thus supply about half the nation's fuel requirements. Fluid-bed burning is a way of cleaning conventional coal of its sulfur while it burns, thus eliminating the high cost of constructing a gasification or scrubber plant. The fluid-bed consists of finely ground coal sprayed into a chamber by hot air and allowed to mix with small chunks of limestone. The appearance of the mixture is that of a boiling "sea" of coal dust with solid "bubbles" of limestone chips, hence the term "fluid." Oxides of sulfur formed in the broth react immediately with the limestone to form calcium sulfate which can then be extracted and reseparated, recyling the limestone.

Finally, one innovation promises not so much to burn coal more cleanly but rather so efficiently that the pollution given off per Btu will be within acceptable limits. As readers of Dick Tracy have discovered, this remarkable process is called magnetohydrodynamics—MHD. By burning the coal at such a high temperature that it becomes ionized, and then passing the charged gas through a strong magnetic field so electrons are drawn off to form an electric current, the system fulfills the old dream of directly converting combustion to electricity. But many technical problems remain before the process, now in demonstration stages (SN: 8/26/73, p. 138), can be used practically.

Whether these innovations eventually bring about a new age of coal depends largely on matters of economics. Utilities now pay between 34¢ and 42¢ per million Btu for coal, depending on its sulfur content and location. Stack gas scrubbing to remove SO_2 would add anywhere from 54¢ to 85¢ to that cost, depending on the emission standards required. Refining the coal with a solvent would add 35¢ to 40¢. This will create enormous pressure to burn low sulfur Western coal near the mining site since there the cost of energy is only 22¢ a million Btu. Even shipping that coal to the Midwest adds 55¢ to 60¢ per million Btu. Just opening new mining capacity is expected to cost $9 billion by 1985.

With cost factors of two or three at stake, the oil, coal and utility industries are girding for a fight to change the Clean Air Act and establish environmental priorities that will allow an easier access to their black gold. □