Special Energy Insider

Synfuels: boon or boondoggle?

by William Engdahl

The Energy Security Act of 1980, signed into law earlier this summer by President Carter is a grab bag of titles covering everything from biomass, alcohol fuels, and urban waste, to creation of an Energy Conservation and Solar Bank with a tag-on mandating addition of 100,000 barrels per day to the U.S. Strategic Petroleum Reserves. It is Title I of this omnibus bill which creates the United States Synthetic Fuels Corp.

In his June 1980 White House signing ceremony, President Jimmy Carter promised that the new synfuels legislation "will dwarf the combined programs that led us to the moon and built our interstate highway system." In terms of merely initial commitment of federal taxpayer dollars alone, he may well be right. In an election year marked by self-righteous howls from congressmen over big federal spending projects, the Synfuels Corporation managed to garner an initial $20 billion for the first five-year phase, with an authorization of an additional $68 billion to be appropriated from anticipated revenues of the Windfall Profits Tax Act of 1980 for Phase II.

A highly controversial aspect of the federal synfuels legislation is creation of the public corporation to stimulate the domestic synfuels industry. Less discussed but potentially holding far greater implications for the future direction of the economy is the unusual way the bill went through Congress. Pennsylvania Rep. William S. Moorhead, with support of House Majority Leader Jim Wright of Texas, engineered its passage in the form of an amendment to the Defense Production Act of 1950. Under rhetoric of national security in event of disruption of Persian Gulf oil supplies, broad sweeping powers have been introduced into this legislation by using legislation originally developed to give Truman emergency "mobilization effort" powers over the Korean War economy build-up. With no declaration of national emergency, the President now has powers to allocate materials and national resources toward the goal mandated in the Act—production of 500,000 barrels of oil-equivalent per day of synfuels by 1987 and a goal of at least 2 million barrels per day (mbd) by 1992.

Within days of its enactment into law, the Department of Energy awarded to 110 projects initial grants totaling $200 million for a variety of feasibility studies, signaling that the scramble for federal capital in scarce markets is on. The scope, claims and implications of the extraordinary manner in which this synfuels venture has been launched warrant careful scrutiny. Are we at the dawn of an era of guaranteed domestic energy independence as the President has indicated, or is the Synfuels Corporation the initial foot in the door for a diversion of national resources that will have catastrophic impact on the shaky economy? The third possibility is simply whether pork barrel-minded legislators have used anxiety over energy supply to justify a $20 billion taxpayer boondoggle to a variety of fly-by-night corporations while far more scientifically promising areas of energy development, typified by the fast breeder and controlled thermonuclear fusion, are grossly underfunded.

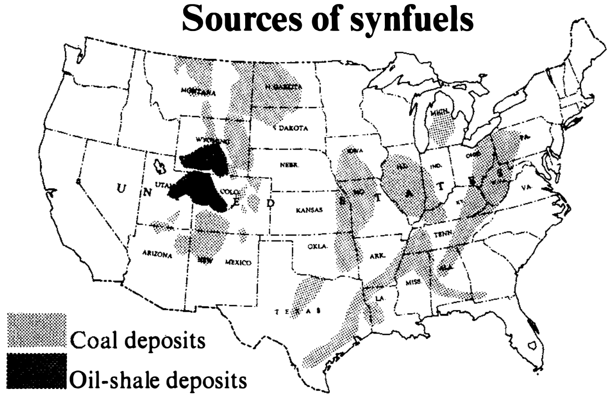
All of the major synthetic fuel technologies have been proven on the pilot-plant scale. This is not at issue. The controversy comes when we speak of scaling up to commercial levels of producing the stated national goal of at least 2 mbd of oil equivalent from these shale and coal synthetics.

The scale of such an industry is staggering. For example, just one 50,000 barrels per day oil shale facility would have to mine, move, crush, and heat over 24 million tons of rock per year. No one is willing to make cost statements, but informed estimates for commercial-scale 50,000 barrel per day plants range anywhere from $2 to $5 billion each.

Water needs in the water-scarce western states alone are enormous and a cause of great concern to agriculture and other industry. Between two and four barrels of water are used up for each barrel of shale or coal synthetics produced. A recent study carried out by the National Research Council of the National Academy of Sciences warned that the Carter administration goal of tripling or quadrupling coal production primarily for synthetics and electricity production over the next two decades "will be difficult even with optimal planning" and that we have never carefully analyzed the ultimate capacity of the lower 48 states to supply water, especially in the water-strapped western states where the major shale and coal reserves for synthetics are located. The recent drought in the West further points up the urgency of broader water resource evaluation for the entire western Rocky Mountain region. This problem has been bypassed by the advocates of synfuels.

The capital goods requirements and bill of materials for development of this new industry are also immense. A recent study carried out by the Congressional Office of Technology Assessment calculated that merely to produce 1 mbd of oil-shale synthetics by 1990 will require fully one-third of the total national capacity of construction and engineering design services and up to

Sources of synfuels



30 percent of total plant equipment capacity produced in 1978 (see chart 1). And this is only 50 percent of the stated national goal of 2 mbd. A recent market analysis for coal synthetics projects a staggering $190 billion in cumulative capital expenditures over the next two decades for plant and equipment, not accounting for cost inflation since 1978. By 1980, the adjusted value alone has reached $250 billion.

Even this is peanut-scale compared with a report recently made public by Exxon, a major investor in oil shale. In a presentation before the Business Roundtable just after passage of the synfuels bill, Exxon chairman Clifton Garvin told a closed meeting of the heads of the nation's largest corporations that the nation must gear up to produce 15 mbd of synthetic oil and gas from shale and coal, over the next 30 years. Their projection of total cost for this scale reaches an uninflated figure of at least *$800 billion* in current prices, $500 billion for shale projects alone.

Inflated cost could push the figure into the trillions of dollars. Exxon recently paid $400 million to buy out Atlantic Richfield's 60 percent share of an oil shale project near Grand Valley, Colorado for a plant scheduled to produce 46,000 barrels per day by 1985. Based on *EIR* computer analysis of the current undercapitalization and depressed state of the U.S. economy, the industrial base could hardly sustain the energy requirements and production needs of diverting resources even for a 2 mbd capacity, to say nothing of Exxon's projected 15 mbd industry.

The heart of the synfuel story, since early synthetics gave way more than 100 years ago to cheap, abundant oil and gas, has been the far higher cost of producing synthetic oil and gas compared with conventional fossil fuels or more recently, nuclear energy. The Office of Technology Assessment estimates that to guarantee a 15 percent rate of return for development of shale oil product could require a price of $62 per barrel of syncrude, making it noncompetitive with conventional crude without massive government subsidies and market guarantees.

This appears to be exactly what Exxon et al. have secured with passage of the Energy Security Act of

Requirements for the production targets

	1990 production targets, bbl/d			
	100,000	200,000	400,000	1 million
Resources	Requirements			
Institutional				
Design and construction services*	minimal	minimal	12	35
Plant equipment	minimal	minimal	6-12	15-30
Economic and financial**				
Loans, $ billion	$0.9-1.35	$1.8-2.6	$3.6-4.2	$9.0-13.5
Equity, $ billion	2.1-3.15	4.2-5.9	8.4-9.8	21.0-31.5
Total, $ billion	3.0-4.5	6.0-8.5	12.0-14.0	30.0-45.0
Annual, $ billion***	0.6-0.9	1.2-1.7	2.4- 2.8	6.0- 9.0
Water availability				
Water, acre-feet/year****	9,800-24,600	19,600-49,200	39,200-98,400	100,000-250,000
Socioeconomic *****				
Workers	5,600	8,800-11,200	17,600-22,400	44,000-56,000
New residents requiring housing and community services	23,000	41,200-47,200	82,000-95,000	118,000-236,000

* % of 1978 US capacity needed each year
** Third quarter 1979 dollars.
*** Maximum annual requirements for a 5-year construction period.
**** Assumes 4,900 to 12,300 acre-ft/yr for production of 50,000 bbl/d of shale oil syncrude.
***** Assumes 1,200 construction workers and 1,600 operators per 50,000 bbl/d plant. Multipliers used for total increase = 2.5x (construction workers) + 5.5x (operators). Ranges reflect phasing of plant construction.

Source: Office of Technology Assessment.

1980. All of this is without reckoning the likelihood of severe cost overruns because of the large demands for labor, equipment and construction services over an uncertain 20 year period of development. Cost estimates for shale plants rose by more than 400 percent alone between 1973 and 1978. This is without consideration for cost overruns caused by environmental or regulatory delays such as have plagued the nuclear industry. In addition, with the current glut in world oil production, OPEC prices are soft. A collapse or even freeze of artificially high OPEC oil prices over this period could totally alter price economics of synthetics. Indeed, the scope of the Exxon proposal, if enacted, would lock not merely that corporation but the entire political and economic infrastructure of the Western world into a regime of rising oil prices. In fact, an argument can be made in light of recent revelations that the recent 150 percent rise in the price of world oil was an artificial response to an overblown picture of the loss of Iran crude, that such price rises by the major multinational oil companies such as Exxon conveniently made the case for development of synfuels more convincing.

The synfuel options

There are two "mainstreams" of synthetic fuel development being considered for production of the initial one-half mbd goal. One involves deriving oil from shale. The other major technology being considered is deriving from coal either liquid or gaseous fuels.

Oil shale

Let's first consider oil shale. The world's largest known deposits of oil shale are located in the United States, with the richest and most accessible deposits in a 17,000 square mile area at the intersection of Colorado, Utah and Wyoming. Most active interest is currently focused on a small area called the Piceance Basin in Colorado's Rio Blanco County (see map). This area is estimated to contain up to 164 billion barrels of oil. In a recent study, the Congressional Office of Technology Assessment estimated that about 400 billion barrels could be "economically" recovered from the tri-state region. By comparison, the United States currently consumes somewhat more than 6 billion barrels of oil per year.

This oil shale contains a carbonaceous, waxy solid known as kerogen. When heated to about 900°F this will yield combustible gases and shale oil. In addition, it yields sodium minerals and a sizeable residue of retorted shale. Although there presently exists no commercially proven oil shale recovery process anywhere in the world, there is research on three basic approaches. True in situ (TIS), is a process in which the shale is first fractured explosively then retorted underground. This is the most experimental technology for shale. (Occidental Petroleum has invested millions in this area.) The second, modified in situ (MIS), is a precess in which a portion of the deposit is mined, the rest turned to rubble explosively and then retorted underground. The third, above-ground retorts (AGR), involves mining the shale in huge open pit mines and retorting on the surface. The result of the processes is a crude shale oil which can be burned as a boiler fuel or converted into a synthetic crude oil (syncrude) by the addition of hydrogen. The syncrude, in turn, can either be burned as a boiler fuel or it can be refined into petrochemicals, especially the heavier distillates such as diesel and jet fuel.

It is the process of transforming the original kerogen into useable refinery feedstock that is the focus of efforts on the part of a number of major oil companies with large reserves of oil shale. The economic cost of retorting the shale and then hydrogenating it when cooled; the cost of removing the toxic spent shale; the degree of air pollution and the water needs in producing the shale; the cost of the large-scale production facilities, all must be reckoned in the calculus of whether oil shale is "competitive." We will look at this in some detail below. For now, it is sufficient to indicate that a commercial commitment to produce even 1 mbd rather than the President's stated goal of 2 mbd by 1992 involves a staggering national commitment of capital resources, plant and equipment, construction services, and water resources.

Coal gasification

Converting this nation's vast coal resources into synthetic gas and liquid form is the second substantial area of synthetic fuels development being discussed by the administration and private industry. The technology has been in existence since an energy-isolated Nazi war economy developed the Lurgi gasifier in 1936. In the more recent period, oil-scarce, coal-rich South Africa, under conditions of increasing political isolation, has developed a domestic coal gasification capability through the government-backed South African Coal, Oil and Gas Corp. (SASOL) using the Lurgi process. The first plant,

The labor aspect

The social implications of the national synthetic fuels program are another entire area for careful study. As a way of "controlling" soaring project costs, it appears that a number of the major construction firms scrambling for the $20 billion federal pie have decided to use nonunion labor for their projects. A study of the construction firms involved to date in negotiations and hiring in Western Colorado revealed that major national construction firms are doing hiring under nonunion or open shop subsidiaries. In one instance, Becon Construction, the nonunion subsidiary of Bechtel Corp. is running ads in the Denver papers to take applications on a $2½ billion oil shale project in Rifle, Colo. Bechtel declined to name the oil company involved. Thus, it appears that federal funds are going to subsidize nonunion activity on a potentially massive scale. In one case, a company found the quality of nonunion workmanship so inferior that it was forced to quietly hire union workers off the books for above union scale to repair the damage. But with federal monies picking up the tab, who cares? ■

which became operational in 1955, now turns out '0,000 barrels of fuel oil equivalent/day. A fivefold expansion program totaling about $7 billion begun in 1974, is expected to bring the daily output to 50,000, still a pittance when compared to the ambitious 2 mbd being proposed in the U.S. synfuels program. In addition, South African coal feedstock runs about $6 per ton compared with a U.S. average of $23. Therefore, the South African experience is not a relevant model for cost economics.

In terms of synthetics from coal, High BTU Gasification and coal liquefaction are the two major areas of development study. In the first generation Lurgi gasification method, small chunks of coal are fed into the top of a pressure vessel where it is met by a combination of oxygen and steam flowing upward from the bottom. Heat and pressure produce methane, the main constituent of natural gas, as well as a synthetic gas of carbon monoxide and hydrogen. This mix is then further processed to remove the carbon dioxide, sulfur and other by-products, to yield a medium BTU gas (350-500 BTU compared with natural gas with 1,000 BTUs per cu. ft.). At this point, the gas can either be consumed as a medium BTU fuel by a limited and relatively inefficient market, or be converted into a mix of liquid or gas products.

The BTUs of synthetic gas can be increased to the point where it can be blended with conventional 1,000 BTU natural gas through a process of "methanation." Such coal gas could then be fed into the existing natural gas pipeline network to industrial application markets. There are a number of alternative methods being mooted for production of high BTU coal gas.

Liquefication

The other branch of development for the coal syngas is liquefaction. The best known method for coal liquefaction is a process developed in the 1920s, again in Germany, the Fischer-Tropsch process. The syngas here is passed over a catalyst which converts it into a range of products from methane to waxes. This is then run through a conventional refinery where it yields diesel fuel, jet fuel and gasoline. Coal liquid for transportation fuel has been the main goal of the South African program, unlike the U.S., where natural gas has been the interest of pipeline companies. All high BTU gasification projects developed to date involve the Lurgi gasifier which has the drawback that it cannot use so-called caking coals of the variety found in the eastern United States, virtually eliminating the nation's richest coal region. Western coal is generally non-caking, the reason the same areas being scouted by major corporations for oil shale are also being sought for synthetic coal projects.

Methanol is the prime object of interest for coal liquefaction. The one billion gallons of commercial methanol produced in the U.S. in 1978 for use in producing plastics, glue and synthetic fibers employed natural gas as a feedstock. Coal is seen as a possible alternative to natural gas to produce methanol. Methanol could also be used as a gasoline additive similar to the use of corn-derived ethanol for gasohol. There are technical problems to be solved, but methanol is viewed as the least costly of synthetic coal liquids. A series of second-generation processes involving direct liquefaction technologies is being considered, unlike the indirect and less thermally efficient Fischer-Tropsch method, which gives a thermal efficiency of 45-60 percent. Direct methods range between 65-70 percent efficiency. Three pilot approaches being pursued for direct liquefaction are the Solvent Refined Coal (SCR) method developed by Gulf Oil and the Southern Co., the Exxon Donor Solvent process, and the H-Coal method developed by Hydrocarbon Research Co. with Ashland Oil, now nearing completion of a pilot plant near Catlettsburg, Kentucky which will yield either a boiler fuel substitute or a range of lighter products such as naptha.