OIL-SHALE DEVELOPMENT

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LEAGUE OF WOMEN VOTERS OF UTAH
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O I L - S H A L E D E V E L O P M E N T

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The League of Women Voters of Utah has had a long-standing interest in the natural resources of our state, with a particular emphasis on water. As our awareness of conservation increased and energy needs became imperative, delegates to the 1973 State League Convention authorized a study of oil-shale development. Mrs. Vern Hamre, State EQ Chairman, with State Board concurrence, has compiled the following material for the League of Women Voters of Utah.

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A tremendous amount of untapped oil is locked in rock called oil-shale. Shale oil resources probably exceed 2,000 billion barrels of petroleum (42 U.S. gallons per barrel) in the United States alone. Scientists and engineers have developed and successfully tested shale oil extraction processes for large-scale pilot operations. When conventional fuels become more costly to obtain, our vast oil-shale resources may provide the options needed to stabilize the future energy situation.

History

Oil-shale is not a new discovery. Every time the prospect of a new energy crisis arises, plans for oil-shale development are brought up and presented as a hope for the future. Each time, in the past, new oil field discoveries have made oil-shale development economically unfeasible. The United States holds the largest known oil-shale deposits, but was not the first country to produce shale oil. Austria produced medicinal oil from its shales as early as 1350. England recorded a patent granted to distill "oyle from a kind of stone" in 1694. Australia, Brazil, Canada, France, New Zealand and Scotland all have produced oil from oil-shale before 1900. Today, Russia, China and Brazil all have oil-shale operations.

In the United States, oil-shale was first known as "the rock that burns" by the Ute Indians. Lean shales of the Appalachia region were used to produce lamp oil, lubricants and some medicines. The 1850's saw the first talk of an oil-shale boom and a plant actually went into operation on the Ohio river. However, in 1859 Colonel S. L. Drake's famous oil well near Titusville, Pennsylvania started the oil boom and put a stop to talk of oil-shale boom. The pattern repeated itself during the 1900's.

In 1915 the U.S. Geological Survey team reported that 20 billion barrels were to be found in the Rocky Mountains. A wild oil-shale land rush followed. Thirty thousand mining claims were filed on federally-owned oil-shale land and nearly two hundred oil-shale corporations were formed. Several operations actually got underway before discovery of the East Texas oil fields once again shelved the oil-shale boom. Oil-shale has been repeatedly at the verge of development but development has never come. Cheaper crude oil sources, government indecision and suspicions of scandals have kept the oil in shale, until today. Now planners for the government and nearly thirty major oil companies are seriously involved in oil-shale projects.

Today

Why today? The current energy crisis has applied the spurs to development, although interest has been growing for the past decade. A growing demand for oil balance against a diminishing supply of domestic crude oil, a major cause of today/s shortages, is the hostoric incentive for oil-shale production. Oil shale is beginning to look not only economically feasible but like a profit-maker. According to Harry Pforzheimer, Vice President of Sohio Petroleum Company, a subsidiary of Standard Oil Company (Ohio) and program director of the Paraho Oil Shale Demonstration, "...at current prices there would be enough economic incentive to go into commercial production with a dependable process." (4)

The energy crisis is seriously affecting the economics of America and the world and the result has been an administrative call for energy self-sufficiency and a federal decision that oil-shale will play a part in reaching that goal. Major oil companies now are gearing up with modern techniques to get the oil out of the shale and the federal government has opened six oil-shale rich public-land tracts for leasing to private companies. Bids for these tracts ran into the millions of dollars.

Geology

What is oil-shale? Oil-shale is a very fine-grained sedimentary rock, marlstone, that contains a solid substance known as kerogen. When heated, kerogen breaks down to form heavy shale oil. Some geologists believe kerogen is actually an incompletely developed oil, which like other fossil fuels, began with microscopic plants and animals buried in shallow waters, but in this case geologic conditions never provided the heat or pressure necessary to convert it to oil.

This sedimentary rock contains enough organic matter (hydrocarbon) to yield ten gallons or more oil per ton when properly processed. Some yield more, and in the United States some thin layers of shale have been reported to yield 140 gallons of oil per ton. Those that are of commercial interest yield from twenty-five to sixty-five gallons of oil per ton.

Kerogen, or the burnable portion of oil-shale, is mostly solid organic matter composed of carbon, hydrogen, oxygen and usually small amounts of nitrogen and sulphur. Some oil-shales, however, contain substantial amounts of bitumen (incombustible asphalt-like material), intimately mixed with solid organic matter. Most oil-shale is dark (black, brown, or dark grey), but some layers of shale are colored yellow, red or green by waxy organic materials. When very thin slices of these rocks are viewed through a microscope, one may see small mineral grains surrounded by dark shapeless masses of organic matter speckled with brilliant yellow, red, or green particles. These particles are probably fossil remains of spores or pollen or filaments of algae, a single celled plant. The remains of other plants or animals may be conspicuous and abundant also. Most of the organic matter in oil-shale, however, is generally so finely pulverized that the nature of fossils cannot be recognized. The shale also contains large amounts of incombustible minerals such as calcite, dolomite, clay, quartz, and feldspar which generally make up more than half the rock.

Oil-shale accumulated as layers of organic ooze and mud on the bottoms of ancient lakes, ponds, lagoons, and shallow seas, in places where plant or animal life was abundant. As these organisms died and sank to the bottom their remains were partly preserved, particularly where the water was stagnant and rich layers of mud were gradually buried as younger sediments accumulated above them, and the weight of the overlying material slowly turned the mud into hard shale.

Geography

In the Mountain West, two prehistoric fresh water lakes - Lake Gosiute, which covered southern Wyoming, and Lake Uintah, which covered Colorado and Utah - and the rising of the Rocky Mountains combined to form the largest oil-shale deposit in the world. This region is known today as the Green River formation, a 16,500 square-mile area covering the connecting corners of Colorado, Wyoming and Utah.

The largest deposits of high-grade oil-shale are in the piceance Basin in northwestern Colorado, a 1,380 square mile area ranging over Garfield and Rio Blanco

Counties. In the southern part of the basin a rich layer known as the "Mahogany Zone" ranging from fifty to one hundred feet in thickness, is exposed in cliffs morth of the Colorado River. In the north-central part of this basin, about one thousand feet of rich oil-shale lies buried beneath five hundred to one thousand six hundred feet of sandstone and lean or barren shale. The oil-shale including the low-grade shale in the Piceance Basin alone has been estimated to contain 1.3 trillion barrels oil equivalent in the rock.

In Utah, layers of oil-shale are also exposed along the south and east margins of the Uinta basin: they increase in thickness and improve in quality below the surface in the eastern half of the basin.

In the Green River Basin, Wyoming, thick layers of rich oil-shale are deeply buried. (See Map No. 1)

PRODUCTS AND BY-PRODUCTS

The oil-shale deposits of the United States can be considered collectively as an enormous low-grade source of oil, hydrocarbon gases, or solid fuel. The known deposits of shales that yield ten gallons or more oil per ton of rock are estimated to contain more than two trillion barrels: their possible extensions may contain an additional three brillion barrels; and, speculatively, other unappraised deposits may contain several times as much oil. Only the highest grade and more accessible oil-shales are of commercial interest. Such potential resources are more than double the proven reserves of petroleum in the country. About eighty billion barrels of oil, however, in the Green River Formation in the Central Rocky Mountains can be considered available with demonstrated methods of extraction and at costs approaching present-day costs of petroleum of comparable quality. (2)

Oil-shale can be burned as a solid fuel or it can be processed to yield oil or combustible gas in varyimg amounts according to the extraction methods used. The principal item of commercial interest in such deposits generally has been oil, but other products can be obtained also. Combustible hydrocarbon gas, for example, has been a major product of some European shale industries. Sulphur and nitrogen compounds, which are undesirable in combustible fuels such as oil and hydrocarbon gas but generally are present in the organic metter of shale, can be recovered separately as valuable by-products but are not likely to be economic as by-products. Sulphur compounds, especially, are expensive to get rid of in an environmentally acceptable manner. The inorganic fraction of some oil-shales also contains materials such as sodium carbonate and phosphate minerals, aluminum, uranium, vanadium, copper, or molybdenum in extractible concentrations. After the oil is removed some of the spent shale may be used for lightweight aggregate. Shipping costs will keep most bulk by-products from being economical.

Production and Extraction Processes

Experiments to extract oil or gas by heating the shale in place (in-situ) have been made on some deposits. If an experimental method for extracting oil from shale eventually proves to be economic on an industrial scale, the potential supply of oil from shale will be enormous.

Above ground retorting usually offers higher oil yields, according to most industry sources. All processes face some large pollution problems in terms of water and air quality and waste disposal. An in-situ process or even a semi-in-situ process such as Occidental Petroleum Company has developed might largely

avoid this. Today such environmental hazards are at the center of the great debate over the impact of oil-shale development.(4)

The best known techniques of oil-shale production use above-ground plants to process the shale. Thus, oil-shale must be mined from the gound in surface mines or in huge underground caverns. While it has been suggested that the Piceance Basin could be surface mined, even most oil company experts label it as impractical. If the ratio of overburden to shale is over one to one, it is probably cheaper to mine it underground. Unlike the rock in coal fields, oil shale provides a good roof, needed for big rooms to permit large-scale underground mining. The underground mines will generally be of room and pillar variety. A series of rooms, limited to about sixty feet in width and height by present technology, would be mined, leaving pillars of rock standing to support the roof. Most industry sources agree that from sixty to seventy-five percent of the available oil-shale would be removed from these mines. (4)

The shale must then go through a series of crushers to grind it down into smaller pieces. It can then be fed into oil-shale retorts where the oil is separated from its host rock.(4)

The retorts are designed to heat the shale to high temperatures, heat being the missing ingredient needed to turn kerogen into a form of crude oil. Once the shale is hot enough, the oil vaporizes and can be removed from the retort. The mining, crushing and retorting operations all increase the volume of the rock. It is estimated that the volume of processed shale will be anywhere from twenty to fifty percent larger than the space from which it was mined. (This is an industry figure, environmentalists place this figure much higher.) Past retorts were usually large brick ovens producing approximately fifty barrels of oil per day. Microwave heat and nuclear energy have been envisioned as ways of unlocking shale oil in the future. Today's retorts, expected to produce from fifty thousand to one hundred thousand barrels per day generally use more prosaic heating methods, employing either gas or oil as fuels. (Types of retorts are found in the Appendix, reprinted by permission from Executive West BENCHMARK Edition, February 1974.)

Production and extraction processes are in various stages of development. Scheduled completion of the Paraho Demonstration Project is for February 1976.(7) Participating companies will have the right to use the process in their own commercial oil-shale plans (on favorable terms).

Participants in the Paraho funding, pledging a maximum of $500,000 each to the thirty-month, $7.5 million project are: Atlantic Richfield, The Carter Oil Company, Chevron Research Company, The Cleveland-Cliffs Iron Company, Gulf Oil Corporation, Kerr-McGee Corporation, Marathon Oil Company, Arthur C. McKee and Company, Mobil Research and Development Corporation, Phillips Petroleum Company, Shell Development Company, Sohio Petroleum Company, Southern California Edison Company, Standard Oil Company (Indiana), Sun Oil Company, Texaco Incorporated, Webb-Chambers-Gary McLoraine Group. (7)

By-Products or Spinoff Products

More than oil can be produced by the oil-shale industry. Rich deposits of caline minerals mingle with the kerogen. Some researchers wonder if the minerals may not eventually be of more value than the shale oil itself. A single oil-shale plant according to the Department of Interior's Impact statement, producing thirty-five thousand barrels of upgraded oil per day, could also yield fifteen percent of the nation's need for soda ash and three percent of the nation's need for alumina. Some fear that unless these saline minerals are

developed along with oil shale they will be lost. Most developers do not plan to recover these saline minerals. All of these processes to produce this along with the shale oil are in very experimental stages. The early spinoffs of the development are more likely to be ammonia and sulfur. Sulfur in Colony's private land are high enough for recovery as a byproduct, and might be recovered to clean up the product. The ammonia byproduct would be available for manufacture of fertilizer. Spent shale could be used for filler for any kind of material sucy as cement blocks, but would not even make a dent in the problem of spent shaoe disposal.

PROBLEMS

Any new large industry has its share of unknowns, uncertainties and challenges. Oil-shale has its share of questions. Will the commercial processes really work? How significant will socioeconomic and environmental impacts be? These challenges include: water availability, water salinity, air pollution, socioeconomics, land use, revegetation, spent shale dispersal, tazes, leasing and oil-shale-state interests versus the nation's interests.

Water Availability

Water is scarce in the region and perhaps will be the most limiting factor. Oil-shale plants are big water users. Agriculture is now the main water user and mainstay of the region's present economy. Will future technology advance so retorts and extraction processes use less water? We will have to base this discussion on present knowledge. Will oil shale water use dry up local ranch and farm land? Industry spokesmen say they will minimize its use of agricultural water rights. Other spokesmen call for an integrated water-use plan as it is believed that oil shale will not be the area's only big user. In Colorado, particularly, new reservoir storage would have to be built, especially along the White River and the Yampa River which are both tributaries of the Colorado River. Ground water under the Piceance Creek Basin would only be adequate until years 1980-1987. If oil-shale development is accelerated new impoundments must be constructed and be operating by the early 1980's. This would include the West Divide (along the mainstem of the Colorado River), Yellow Jacket and Yampa River reservoirs (on the White and Yampa Rivers), among others. New impounements would take from five to seven years each to construct after they are authorized and funding is obtained. So any decision reached to accelerate oil-shale development must also carry with it an implicit commitment for dam construction. To be available in the early 1980's construction would have to bagin in 1975. The Yellow Jacket and Yampa projects are only in the planning stage. The West Divide project is authorized but not under construction. The three projects could provide up to 277,000 acre-feet of water for oil shale development, if constructed. One or more impoundments may never be built because statistically Colorado has only 167,000 acre-feet of water remaining which is uncommitted under the law of the Colorado River (compacts and Mexican Water Treaty).

The upper Basin states, Colorado, Utah, Wyoming, New Mexico, get about half of the water in the Colorado River drainage. Since the White River is one of the main sources for water and flows into the Green and eventually into the Colorado, some of this water belongs to users in Arizona, Nevada and California, the lower Basin states. The Colorado River compact was signed in 1922. In 1948 the Upper Colorado River compact was created, which provides that Colorado gets fifty-two per cent of the water rights in the drainage, Utah - twenty-four per cent, Wyoming - fourteen per cent, and New Mexico - eleven per cent. That, at best is

about 1.5 million acre feet per year in an average water year for Utah. Right now there is plenty of water for initial development, but what is in the future?

Some possibilities suggested are to construct a dam on the White River and storage facilities on the plateau where the deposits are located.

Under terms of the Upper Colorado River Basin Compact, Utah was granted 1,322,000 acre-feet annually, to be taken from tributaries of the Colorado originating in Utah or from the river itself. New energy extraction projects in this Utah part of the Colorado River Basin drainage system and water for them is thus subject to limitations of the compact allocation. With present annual depletions of 684,000 acre feet, Utah has 638,000 acre-feet still unused, but 531,000 acre-feet of this is committed for future use, largely for the Central Utah Project (CUP). That leaves 107,000 acre-feet of Colorado River water unused and uncommitted for investment in new eastern Utah projects. On file with the Water Rights Division at the present are applications for more than twice the 107,000 acre-feet available (359,000), just for oil shale development alone in the White River area of the Uintah Basin. In Utah some water for oil shale development and related municipal use could be obtained from the Jensen, Upalco and Uintah units in the CUP, and the construction of the Yellow Jacket and Yampa projects in Colorado could provide additional water for use in oil-shale development in Utah. Both Utah and Wyoming will have enough water to use under an accelerated oil shale development program until about 1990. More development might take place in Utah and Wyoming oil shale than would otherwise be the case if more Colorado water were available. Construction has just started on the Jensen unit, and the Upalco and Uintah are only in the planning stage, so the Utah projects are a long way from completion also.

Other minerals and fuels developments such as nahcolite, dawsonite and new coal developments could likewise cut into the amount of water available in Utah and Wyoming, although water constraints are not so binding as those of Colorado.(5) The Bureau of Land Management thinks the development in the Green River can meet culinary needs and other non-industrial uses through wells, but to meet continued shale development some storage facilities will have to be constructed. Changing from an irrigation to an industrial use can be a long legal process. Legal problems are also involved in the dubious cloud-seeding project of the Bureau of Reclamation, which they claim could go operational by 1980 and might provide an additional two million acre-feet annually to the Colorado River Basin. Finally and hopefully, technology might find ways to reduce the use of water for oil-shale development. (5)

Utah faces hard choices. The State must re-examine present commitments of the water for future uses long deemed in Utah's best interest--principally the Central Utah Project, if water needs for energy extraction are to be fully met without disturbing present depletion patterns or barring additional Colorado River allotments.

Water Salinity

The long-term effect of industrialization would result in a decline in water quality. Oil-shale plants will draw relatively fresh water out of the Colorado River, and not return any, thus increasing the river's salinity. Water quality impacts will be focused most directly on the White and Green Rivers and ultimately on the Colorado River System. The potential for serious degradion exists, but due to the uncertainties inherent in many of the individual impacts, the degree of severity cannot be quantified. The most discussed facet is water consumption. Downstream irrigation projects are much worse offenders than oil-shale plants should be, but the Colorado River has no margin of safety. Proposed

solutions include lining irrigation ditches with concrete, building expensive desalting plants and diverting some natural salinity sources.

Air Pollution

The oil-shale region suffers from air inversions -- air pollution compounders. Transportation raises the major air pollution problem expected from oil-shale development. Most believe the region will need careful land use planning and good mass transit systems to prevent population growth from causing hazardous air pollution. Air pollution from oil-shale plants themselves is still an unknown, though much debated quantity. Colony Development operation feels that with their private land plant up on the plateau that emmissions can be easily dispersed. The Institute of Ecology feels that most plant sites are in the worst air basins.

Colorado has a stiff air quality standard - 10 micrograms per cubic meter of air for sulfur dioxide by 1980. This supposedly should preclude oil-shale development in the Piceance Basin in Western Colorado beyond 200,000 - 300,000 barrels per day which is near the production level that may be achieved under prototype development. The Environmental Protection Agency must soon determine what constitutes "significant deterioriation" of air quality, on order from the federal courts. Prevention of "significant deterioration" of air quality has been written into the four test leases and EPA's determination on this point will directly affect "not only oil-shale but any mineral development in Colorado, Utah or Wyoming." Under new rules proposed by EPA, state and local offices could permit drastically higher levels of air pollution in areas where the atmosphere now is cleaner than required by law.

Environmental Studies

The area is a semi-arid region of ridges and valleys with cliffs of rock and a population of only three persons per square mile. Wildlife is prevalent in the area and vegetation provides winter browse for large mule deer herds. It is an important open range country. Many fear the scramble for energy will create a "New Appalachia". It is clear that above ground technologies do involve several tremendously complex environmental problems. For the past five years these problems have been the focus of a series of environmental studies, the most notable having been carried out by the Colony Development Operation - the company probably closest to a commercial development. Since 1969, Colony has generated more than one hundred environmental studies performed both by Colony and outside research groups, at a total cost approaching three million dollars. The Interior Department used extensively this information in preparing its final Environmental Impact Statment (EIS) on the oil-shale leasing program. Some environmentalists contend that the Colony studies were done on too small a scale to solve, or fully predict the problems of a full-scale commercial plant. Colony admits that solutions for large-scale problems are not proven. Most sources agree that a few plants are needed for further study and to refine, and perhaps improve current technologies. But, the reality of cold houses and lost jobs is speeding up all resource development -- perhaps too quickly for the problems to be solved. Some see a loosening of environmental goals -- some say temporary. Some groups favor the creation of wildlife refuges in the area, as the development and urbanization will unavoidably take large amounts of land away from the agricultural and open range areas of the region. Many believe the fate of the deer herd and other wildlife, rests in large part on the success of revegetation of processed shale that must be disposed of.

Spent Shale and Revegetation

Large land disturbances are already a sore spot for many Intermountain West residents. According to the Leasing EIS, a million barrel per day industry will disturb eighty thousand acres of land over a thirty year period and twenty thousand acres, one forth of this area, would be in a totally unreclaimed state at any one time. Every day Mountain West residents watch more and more of their scenic areas go to developers, coal mines, uranium mines and now to oil shalers. The largest problem and toughest questions on land use come in regard to their mines and especially their spent-shale piles. Some oil critics have charged that the industry could change the whole topography of the region by mining into plateaus to get at the shale and then by dumping the former high ground in the form of spent shale, into valleys. Oil spokesmen contend that the topography change in the 16,500 square mile shale region will be insignificant. (Note: one square mile equal six hundred and forty acreas.) Proponents believe that after filling up one-fifth of the area they would be mining to an average depth of three hundred fifty feet, and if the waste is properly revegetated, it would be difficult for the non-expert to distinguish it from native surroundings.

But -- can it be revegetated? No one knows what the result would be in five, ten, or even twenty years when some of the effects of the total process would begin to show. Spent shale disposal has generated some of the most heated debates over oil-shale development. The volume of the rock swells as a result of the mining, crushing and retorting processes. Developers do plan to wet and compact the retorted shale, but it will still be larger than its original volume. The technical knowhow for refilling active mines is not yet at hand, but it may be possible to return some spent shale to abandoned mines.

The revegetation process involves first plowing the area, then putting on mulch and fertilizer, sowing seed (mainly grass) and finally putting in irrigation pipes - claiming that irrigation should only last three years. The fertilizing process may have to last for twenty to twenty-five years. The irrigation process would have two functions: first, to help the vegetation grow , and second to leach salts out of the soil. Spent shale is a highly salty substance and salts must be leached out of the surface of a pile before vegetation can grow on it. This also gives rise to the recurring question of salinity and the Colorado River. Ecologists fear that natural erosion, flash floods, which are common in the area, and the possibility of salts seeping into the underground water supplies, could all greatly increase the salinity of the Colorado River. Industry sources believe all these problems can be controlled through dams, recycling and careful management. According to the Institute of Ecology, if the oil shale companies are wrong, their error could be very costly. The Institute estimated in its critique of the Leasing EIS that:

> "even if one percent of the salt is the spent-shale piles were to escape into the tributaries and into the Colorado River, the damage would be severe to downstream users - a $5,293,000 burden by 1999."

Controlling salinity in the spent-shale depends very heavily on the success of revegetation and many environmentalists fear revegetation will not work. There is controversy as to whether the spent shale is sterile or not. The question still remains, can the spent shale be revegetated on a long term basis? In the final environmental impact statement all they are talking about is three species of grass.

What about browse? The question of the browse species is a crucial one for environmentalists and wildlife. Browse is the mainstay of the deer herd. Another problem is where to get seed for revegetation because native seeds adapted to the site will grow better even though nativeseed germination is very

low. The SCS is working to introduce native seeds to commercial seed growers. Most of these environmental questions will probably remain unanswered until at least one or two commercial plants come on the scene and industry, government and environmental research can continue on a commercial scale.

Socioeconomics

Oil shale will bring benefits - jobs, money, increased tax base, economic growth - but also the major worry - boom town woes. The common effects of booming economies in rural areas, are sociological boomerangs such as soaring rates of petty crime, and economic boomerangs such as rising taxes. Tourism and agriculture may suffer from the oil shale land and water use. The responsibility of planning for these potential problems rests largely on local governments, which may be ill-equiped for the task. Tremendous coordinated efforts are needed by government officials, oil-shale developers, etc, in planning for the coming boom. While oil shale will generate a large tax base, most sources believe that the oil-shale related population and the need for people-oriented services like schools, sewers, power, roads, hospitals, etc. will come before the tax base provides the needed revenue. A major tax lag may develop - so that major funding problems are initially in store for the counties. Some proposed solutions call for federal grants to cover tax lag costs. Some suggest this could be eased by prepayment of taxes by the oil-shale companies - if state laws permit. The Institute of Ecology in its critique does not believe that the socioeconomic and environemntal effects of required support facilities, such as electrical generating plants, reservoirs, highways and pipelines have been adequately analyzed.

Many of the problems in accelerating oil shale development are the same as for any minerals development or any new industry: making the resource attractive enough to attract venture capital; meeting power needs (400,000 to 700,000 Kilowatts); finding engineering talent and some types of craftsmen, notably pipefitters; locating equipment and materials; meeting rising costs of everything, especially labor and equipment; coping with long delivery times on vital equipment; planning for and providing for new facilities and public services in the affected areas to meet the needs of the increased population. Another problem is a possible decrease in the agricultural economy due to shortage of water and labor.

Leasing

In November 1973, Secretary of the Interior, Rogers Morton announced the oil-shale prototype leasing program. The leasing program injected a stream of specifics into a controversy characterized mainly by question marks. The program opened six five thousand acre oil-shale tracts, two in each of the three oil-shale states, for competitive bidding by private companies. According to the Department of Interior, developments on these tracts are meant to provide needed information on this new industry, both in terms of its commercial viability and its environmental impacts. The details also opened a new area of contention. Critics of the Interior Departments prototype leasing program charge that its deductions and credits are large enough to make the leases "giveaways". Most of the critics say that the oil companies developing shale do run risks. And they agree that incentives are necessary to stimulate the development of a needed energy resource - but they do not like the amounts or terms allowed by the federal leases. And, some add, the lease does not require production rates that would justify the leasing terms. Program advocates, who see the competitive bidding process as a government hedge against any "giveaways" say the lease terms included incentives to get the winning bidders to accelerate their plans for development and commercial plants. The program still has many critics, from federal congressmen to environmental groups.

The money involved is a major factor in the controversy. The federal government will receive money from oil-shale industry in four forms: bonus bids, royalties, lease rentals and taxes. Many environmentalists, and some public officials charge that the special provisions of the program will reduce these payments appreciably.

THE OIL SHALE TRACTS

Tract	Amount (Actual)	Estimated Oil (in barrels)	Shale Reserve (in tons)	Extraction Method	Saturation (per ton)
Colo.1	$210,350,600	1.32 billion	1,857,000,000	Mining	30 gals.
Colo.2	117,788,000	722.8 million	1,012,000,000	Mining	30 gals.
Utah 1	75,000,000	24.4 million	342,000,000	Mining	30 gals.
Utah 2	45,000,000	25 million	372,000,000	Mining	30 gals.
Wyo. 1	Not leased	16.8 million	354,000,000	In-situ	20 gals.
Wyo. 2	Not leased	17 million	352,000,000	In-situ	20 gals.

The first tract was for 5,120 acres, the second for 5,094 acres. The third along the White River just west of the Colorado border in Utah was 5,000 acres and the fourth for approximately the same. The Wyoming tracts have not been sold.

However, Governor Rampton is asking the Interior Department to transfer 157,000 acres of the land to the State of Utah. Utah wants the land to compensate for school land taken by the federal government years ago. Under ordinary circumstances, the transfer might be considered routine, but since the beginning of the energy crisis and shale development programs, there's a whole new light on the situation. The land involved includes both of the Utah areas selected for oil shale prototype development sites.

Utah's Democrats in Congress, say the Interior Department has delayed too long in acting on the state's application for the land transfer, which has been pending since 1965. Senator Bennett shares their views, but has not joined the Democrats in complaining. Therefore, Utah deposits are in the middle of a nation/state tug-of-war. But, the lease sales were not stopped. Until the question is settled in the courts, the lease sale money will go into trust; the royalties will be held in escrow. Plans now are for the two lease sites to be joined in a compromise to build only one plant between them, with the combined output to be one hundred thousand barrels per day. Approval for this has been granted.

Environmentalists, pointing to Utah Governor Rampton's stated desire to go full-speed ahead on development, fear that environmental regulations will be lowered on the Utah land, although the governor vows to follow all federal requirements. Critics of Utah's request have charged that Washington should not give away such valuable public land. The governor points out that it asked for the land six years ago, before it was considered valuable. Nevertheless, whether oil-shale development comes under the auspices of the state or federal government, Howard Ritzma, assistant director of the Utah Geological Survey says that the majority of Utahns look forward to development. Ritzma says,

> "Utahns main concern over development is that Utah oil-shale workers will live across the border in Colorado, thus compounding tax-district problems."

New lease sales of public lands would have to be made between 1977 and 1980 to accelerate oil-shale development. Acreage would have to be larger than the present 5,120 acre tracts to assure successful lease sales, especially in Utah and Wyoming. Perhaps oil-shale lands should be leased by a reserve unit rather than by acreage, which would require a change in the law. (See Map No. 2 - Oil-Shale Tracts.)

OIL SHALE ENVIRONMENTAL ADVISORY PANEL

The Department of Interior, early in 1974 established an advisory committee to advise the Bureau of Land Management, the Mining Supervisor of the U.S. Geological Survey, and other employees of the Department of Interior "with respect to environmental matters involved with the exercise of their responsibilities" in the Federal Oil Shale Leasing Program. This rather broad charge required the Panel at their initial meetings to focus on defining their task. Other duties of the Panel include helping to coordinate public hearings and preparing an annual report to the Secretary of the Interior on the environmental aspects of the program.

The Oil Shale Environmental Advisory Panel is made up of representatives from most federal agencies connected with land management, state representatives appointed by the governors of Utah, Colorado and Wyoming; county representatives from the most directly affected areas in each state; and at-large appointees from the Secretary of Interior (See Appendix for list of members.) By law the panel must be "consulted" on all environmental matters to do with oil shale leasing. The main business of the panel seems to be the reviewing of environmental impact statements, approving the placement of roads, etc., and mainly trying to assure itself that the oil companies are showing proper concern for air quality, fish and wildlife, water quality, and the preservation of antiquities.The oil companies make their presentations, the BLM representatives explain how environmental impact is to be minimized, the panel goes over the details and recommends changes which are then formulated into guidelines to be presented to the director and mining supervisor of the U.S. Geological Survey. The meetings are open to the public, both for observation and for questions and statements. The panel has been meeting at various locations in the three states.

While the committee is given a broad environmental charge, it is given no powers. The Mining Supervisor (in USCS) is the trustee of the leasing program. The Supervisor approves the exploratory plans and the mining plans, which include reclamation. The Supervisor will not ordinarily take any action without consultation with the panel; however, when he finds it impractical to get comments from the panel, he is free to waiver that requirement. For example the supervisor is given further discretion to waive the prime revegetation goal in the leases.(12)

Since the Mining Supervisor is given wide discretion by the lease arrangement, it is crucial that he receive adequate and complete advice. That is the proposed duty of the committee. But the committee has a duty to the public as well, and that function is to use its influence to see that its advice is incorporated into the leasing program. The panel has potential. However, the personnel on the committee will determine if it will be an ornament on Interior's tree or a part of the nutrients for a well-planned leasing program. It is early to tell, but encouraging that the amount of homework being done by panel members and their increasing awareness that this is an environmental advisory panel and not a technical one.

SUMMARY

Will oil shale development become a reality? Some say yes -- that all its obstacles can be worked out. Somesay no -- that the obstacles are insurmountable and that it is all a political move to reduce the price of oil from other sources.

Prototype studies are under way in the three states of Colorado, Utah and Wyoming, but although the oil shale deposits are extensive, no feasible way of extracting oil has yet been found. Paraho facilities projected completion date is uncertain. Other Demonstration projects seem to be still very theoretical.(18) Development would require major changes in tax incentives, relaxation of pollution rules and development of huge amounts of water. An FMA report states that by 1990 89% of Colorado's and Utah's undeveloped water would have to be developed and 45% of Wyoming's would have to be developed. A dam building program would be required. Colorado's air quality standards would have to be relaxed. Current water compacts would have to be rewritten. The cost of salinity to the Colorado River Basin outside the oil shale development region would be mostly in agricultural losses. Growth and long term environmental changes would take place. The problems of new cities would arise. If the proposed development is to be reached, long term committments must be made. (Development of other energy sources may in time take care of our energy needs.)

DISCUSSION QUESTIONS

1. What is the real problem of oil-shale development?

2. What are the relative values of environmental goals to oil-shale development?

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I would like to give particular credit to the editors and publishers of Executive West BENCHMARK Edition for permission to reprint from their Bebruary 1974 edition their information on the technology of production and retorts, and their synopsis on leasing. These are separate in the appendix. Other credits to them have been noted in the text.

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RETORTS

Reprinted from Executive West BENCHMARK Edition, Feb. 1974

Bureau of Mines: Gas-combustion Retort at Anvil Points near Rifle, Colorado. This retort is a vertical vessel through which crushed shale moves down by gravity and hot-recycled gases move up from the bottom. The combustion of these gases and some residual carbon in the spent shale results in rising hot gases that heat the raw shale to retorting temperature. Oil vapors and gas rise to the top of the retort, where they can be removed. The oil from this retort, like oil from most retorts, is a thick liquid called crude shale oil and must be upgraded before it can be piped to refineries.

Union Oil Retort: Developed and tested at the company's Parachute Creek Mine in Colorado, this retort is often referred to as an upside-down gas-combustion retort and the raw shale is moved upward by a rock pump while the gas flow is downward. Heat is also supplied by the combustion of the carbon on the spent shale. Shale oil condenses on the cool, incoming shale and flows over it to an outlet at the bottom of the retort. Union Oil conducted its test from 1956 to 1958 and abandoned the plant, saying that when economic conditions warranted, the process could be commercialized. Union has announced plans for a fifty thousand barrel-per-day plant in Colorado by 1979.

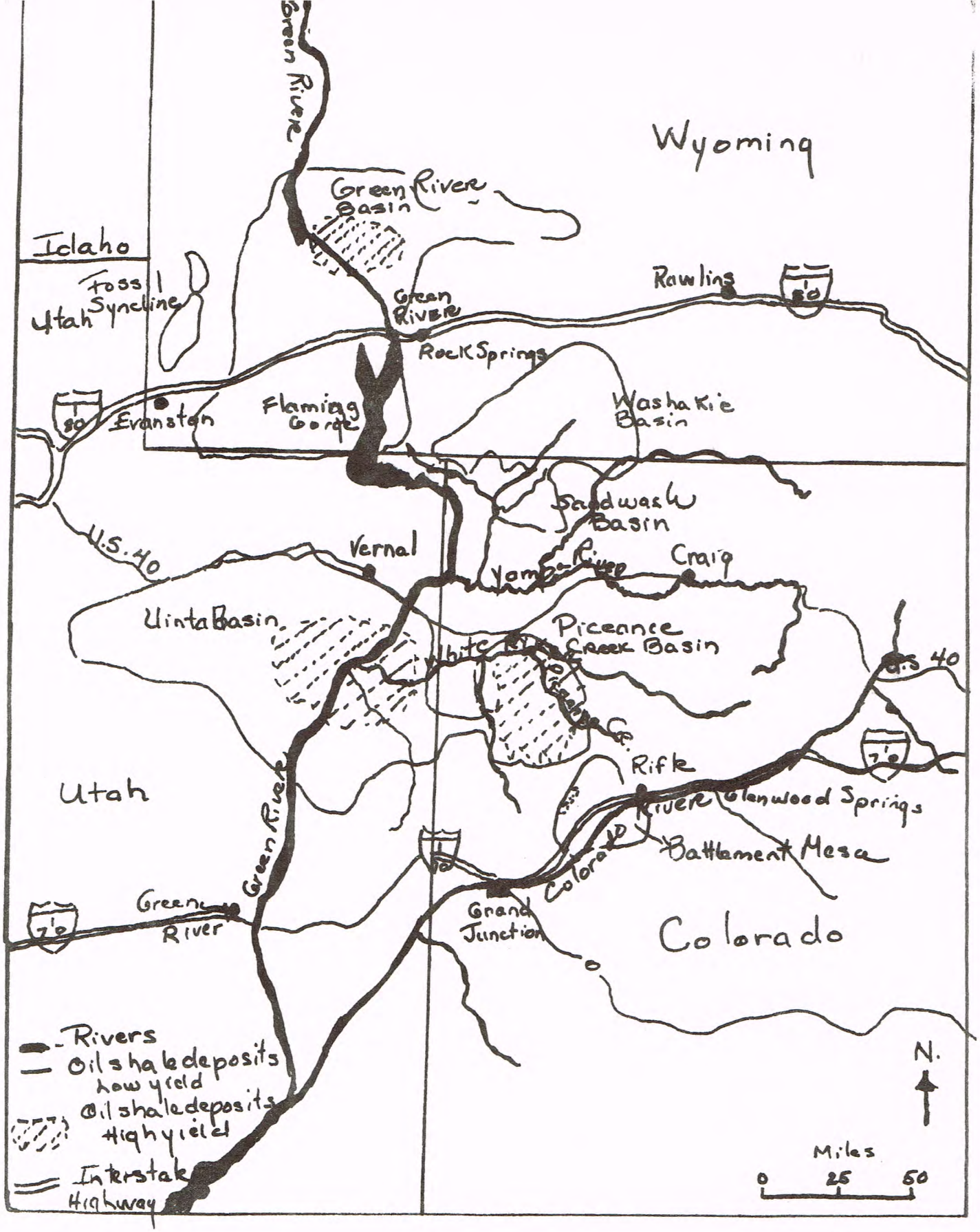
Paraho Retort: The Paraho Retort is a simplified cylindrical gas-combustion retort based on a series of inventions by John B. Jones, president of Paraho Deveolpment Corporation (Denver), a licensing and engineering development company funded from seventeen companies. Testing will be at the Bureau of Mines Anvil Points facility. It will be tested in both internally-heated and externally-heated versions. It is already in successful commercial operation on limestone, a close cousin of oil-shale rock, marlstone. The retort has the widely accepted advantages of a continuous vertically descending bed of granular material, which has always been a major problem with previous gas-combustion test programs.

TOSCO II Retort: A Retort developed by the Oil Shale Corporation (TOSCO), will probably be the first commercial oil-shale plant. Colony Development Operation, for the past ten years, a consortium of companies with Atlantic Richfield as the operator since 1969, has worked on oil-shale development at their privately owned land near Parachute Creek. TOSCO is a fully-developed process with plans already well underway to build a full-scale commercial plant on their property. TOSCO is a rotary type retort that uses hot ceramic balls to heat the shale in the retorting process. The raw shale is crushed to a size of one half inch or smaller, the smallest size used in any retort, and then preheated before being fed into the retort with the ceramic balls. The balls transfer heat to the shale, thus eliminating the need for internal combustion, and the oil vapors and gas rise to the top of the retort where they are removed.

IN-SITU (In Place) Processing: In-situ processing, where the shale is heated underground, eliminating both mining operations and large processing plants, have been talked about hopefully for years by environmentalists and scientists. Not all oil-shale retorting need be dome above ground. In general terms, an in-situ development would involve the drilling of several wells, some to introduce heat into the underground shale deposit and some to draw up the oil and gas produced by retorting. Another proposal involved exploding a nuclear device underground to create a chimney of broken rock. Under ground heating suggestions have included the creation of combustion in the oil-shale formation,

the introduction of hot natural gases, or the introduction of superheated steam. One problem that stymied the in-situ development is permeability. Lines of communication must be opened in the solid rock to allow passage of gases and liquids. Most sources claim it is still a problem despite some successful tests carried out on fracturing the underground deposits for permeability. Control, with any accuracy, is the other difficulty in the process, since the retorting is all done underground. Most oil industry spokesmen claim the in-situ process will not be feasible for a least a decade, but several oil companies have worked on it in the past and are currently working on the process. The one receiving the most attention is one developed by Occidental Petroleum. It began testing its new in-situ process on private holdings in Colorado. Recent reports claim that the process has produced thirty to forty barrels of shale oil per day, and that it can be used on most oil-shale deposits in the Piceance Creek Basin, and that it involves little environmental damage.

The Occidental Process: This process deviates from the basic in-situ process in that it does require some mining. The company digs a large room in the shale deposit instead of drilling wells and using explosives for permeability. Explosives are detonated in the room, filling it with rubble, or chunks of oil shale. Air and fuel are forced into the room from the surface above the mine where they are ignited and bring the shale to retorting temperature. Shale oil seeps through the rubble and gathers in a sump where it can be pumped from the mine. The "ifs" in the Occidental process are how to control retorting on a large scale and whether it can be successfully scaled up for a commercial-sized process. Should these problems work out, some claim it is the best hope for a clean oil-shale process in the future - even though it will have some pollution problems such as waste gases.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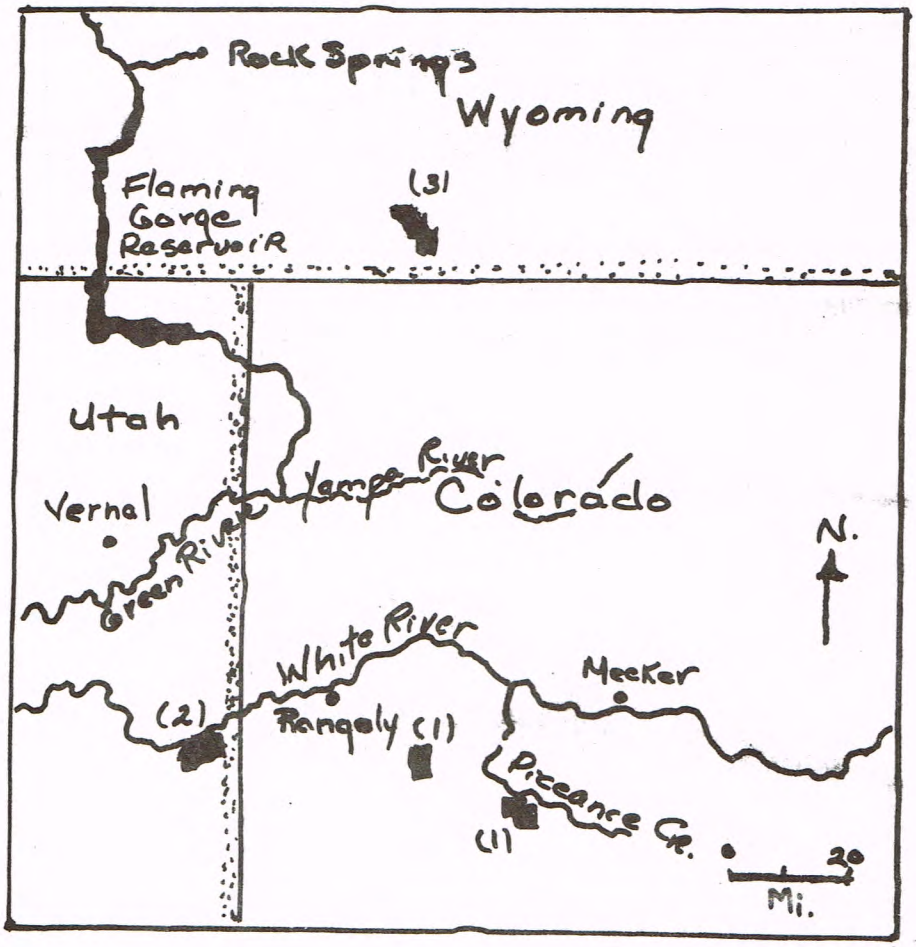
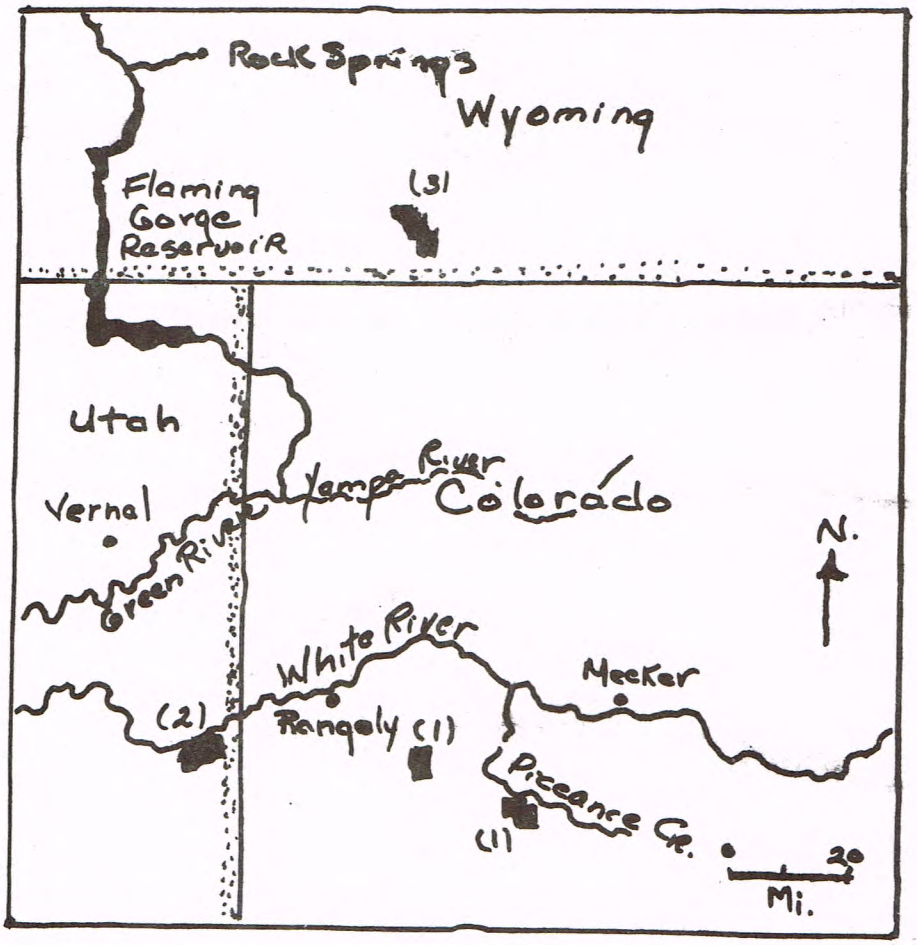


Oil-Shale Tracts

- (1) – Colorado
- (2) Utah
- (3) Wyoming
- State lines



Oil-Shale Tracts

■ (1) – Colorado

■ (2) Utah

■ (3) Wyoming

State lines

LEASING PROGRAMS

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Lease Length: "This lease shall be for a period of twenty Lease Years from the Effective Date and so long thereafter as there is production from the Leased Deposits in commercial quantities...."

The Bonus: "This bonus shall be due and apyable in five (annual) installments .... In the event the Secretary accepts a surrender or relinquishment of this lease.... That release shall not releive the Lessee of the obligation to pay installments which had accrued prior to the filing of the surrender of relinquishment of the lease."

Bonus Credits: "The Lessee may credit against the forth bonus installment any expenditure prior to the third Anniversary Date directly attributable to the preparation of a development plan.... Similarly, the Lessee may credit against the fifth bonus installment any expenditure prior to the forth Anniversary Date directly attributable to operations under this lease on the Leased Lands...but not any expenditures attributable to the preparation of a development plan."

Rentals/Royalties: "Rentals for any Lease Year shall be credited by the Lessor against any royalty payments for that Lease Year."

Other Minerals: "The Lessee shall also pay a royalty on all minerals other than shale oil contained in Oil Shale produced from the Leased Deposits which the Lessee processes, either on or off the Leased Lands, or sells."

Extraordinary Environmental Costs: "If the Lessee shall show that compliance with the requirements for environmental protection... has engendered or will engender extraordinary costs in an amount which is in excess of those in the contemplation of the parties as determined by the Lessor... the Secretary, if he deems it desireable, may, in order to offset such costs, adjust the royalties that would otherwise become due and payable by allowing a credit against those royalties."

Royalties: "If the shale oil content of the Oil Shale mined is more than thirty gallons per ton, the basic royalty rate per ton shall be increased by one cent for each gallon or fraction thereof that the shale oil content is more than thirty gallons per ton."

Minimum Royalty Credit: "The Lessee may credit against any minimum royalty due on the sixth Anniversary Date or any subsequent Anniversary Date up to the including the tenth Anniversary Date, the amount of any expenditures... which are directly attributable to operation of the Leased Lands... for the development of the Leased Deposits and which were not credited against the fourth and fifth bonus installments."

Reasonable Prices: "The Lessor reserves full authority... to insure that any sale of the production from Leased Deposits to the United States or to the public is at reasonable prices...."

STATE REPRESENTATIVES (Cont.)

Utah

Gordon Harmston, Executive Director
Utah State Department of Natural Resources
Salt Lake City, UT

Charles Hansen, Director
Utah Division of State Lands
Salt Lake City, UT

Mrs. Jeanne Stringham
National Wildlife Audubon Society
Vernal, UT

Wyoming

John T. Gooier, Chief
Mineral Development
Dept. of Economic Planning and Development
Cheyenne, WY

Dr. Daniel N. Miller, Jr., State Geologist
Geological Survey of Wyoming
Laramie, WY

Carl A. Gaensslen
Audubon Society
Green River, WY

COUNTY REPRESENTATIVES

Robert White
Rio Blanco County, Colorado
Rangely, CO

Charles Henderson
Uintah County, Utah
Vernal, UT

L. W. Jones
Sweetwater County, Wyoming
Tock Springs, WY

APPOINTEES OF SECRETARY OF INTERIOR

Dr. Thadis Box, Dean
College of Natural Resources
Utah State University
Logan, UT

Rep. Michael L. Strang
Colorado House of Representatives
Carbondale, CO