

AN OVERVIEW OF THE DOE OIL SHALE
RESEARCH AND DEVELOPMENT PROGRAM

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Coal was the energy king into the early 20th century; petroleum has been king since then, and appears most likely to remain so into the 21st century. Sometime in the 21st century other forms of energy must start to replace petroleum as the growth in worldwide supplies begins to wane and, demand exceeds supply. Oil shale can be expected to be an important resource. The similarity of oil shale liquids to crude oil may give shale oil advantage in the competition for liquid fuel markets. Still, shale will be able to compete economically only when crude oil price becomes sufficiently high to match the higher costs of shale oil on a long term basis.

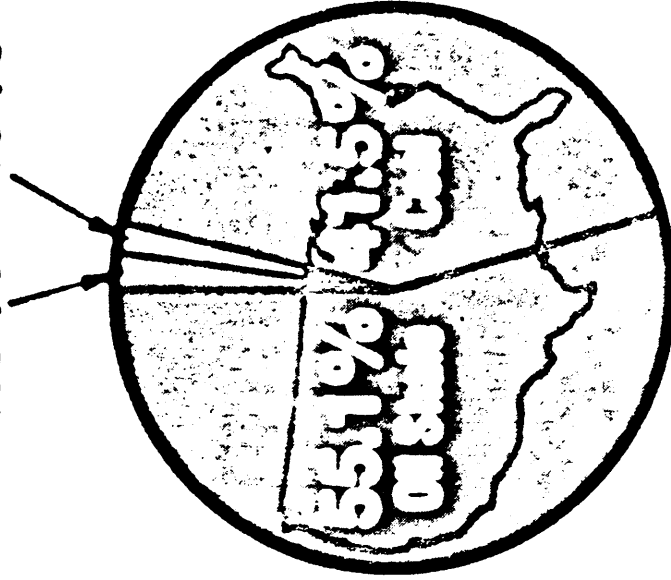
When that happens, and oil shale is called upon to play a major role in the energy balance, the United States is well-positioned. As a resource, oil shale is second only to coal, worldwide, on a BTU basis, and the United States has the major share of the most promising deposits. (See Figure)

The key question becomes -- when will this resource be needed? Oil shale development on a large scale has appeared to be just over the horizon since World War I. Each time development appeared imminent, abundant supplies of low priced oil doomed progress -- most recently in the early 80's. Presently, the only large scale plant constructed and operating in the United States is the Unocal facility in Parachute, CO. It was built under a price guarantee from the Synthetics Fuels Corporation in the early 80's. Except for the recent proposal by Occidental Oil Shale Inc. for a jointly sponsored Modified In Situ Demonstration Project on Tract C-b, other interests in oil shale development have been deferred for the indefinite future, including Exxon's Colony Project and Amoco's Rio Blanco Project on Tract C-a.

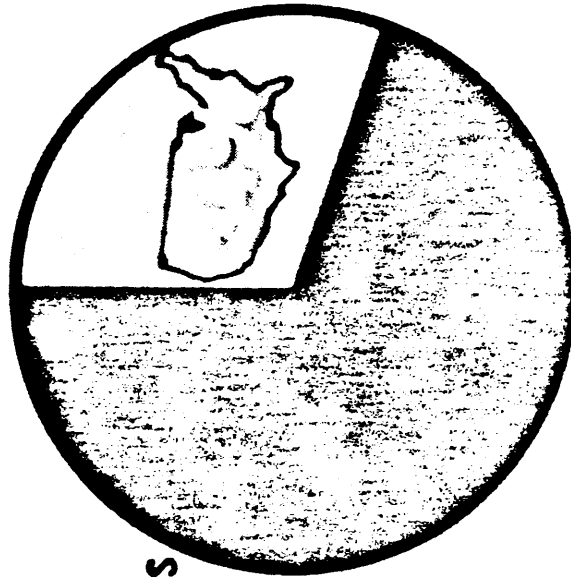
The Department of Energy has had an oil shale R&D program for many years. The DOE program activities are directed toward fostering the development of an economically competitive and environmentally acceptable industry. Just as abundant and low priced crude oil impacted industrial oil shale activities, so have they also affected DOE's oil shale program. The compelling need for competitive new energy supplies in the early 80's, supported larger budgets. At that time, oil shale R&D funding was as high as \$19 million. After crude oil prices dropped and other national priorities became more pressing, the urgency for alternative fuel supplies became less crucial. DOE saw this period as an opportunity to postpone research, as industry has, to help meet other national priorities. Annual funding level dropped to the present level of about \$9 million.

Estimated Recoverable Oil Equivalents

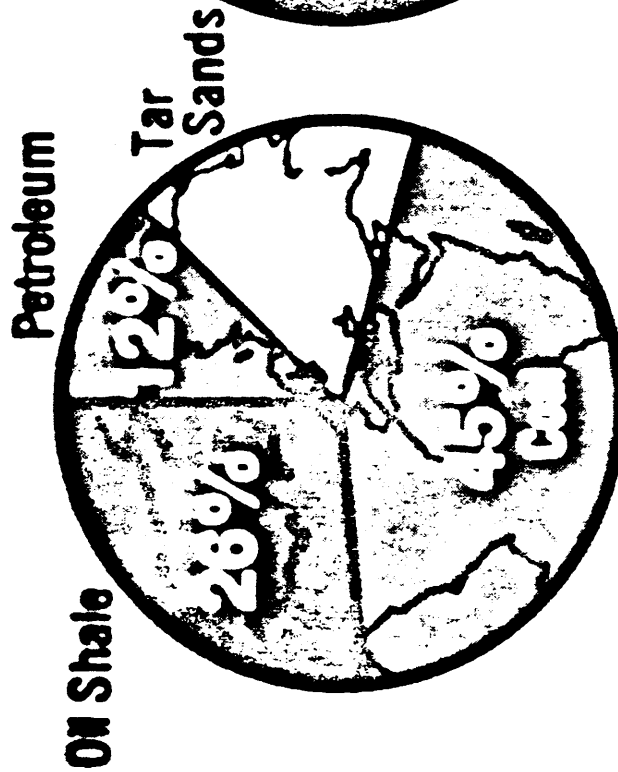
Petroleum 1.8%
Tar Sands 1.6%



U.S. Distribution



U.S. % of World Total
1929 billion bbl



World Total
5749 billion bbl

Research activities supported by DOE are aimed at reducing costs and resolving environmental issues. The costs are pretty evenly distributed among the major steps involved in producing shale oil. DOE projects to reduce cost are ongoing on most of these steps including mining, feed preparation and material handling, retorting, and waste disposal. No research is being done on upgrading.

Mining activities include research on blasting models, safe explosives, water jet assisted mining machine and shale beneficiation.

In the surface retorting area, there is research on the hot recycle solids retorting process being developed by Lawrence Livermore National Laboratory (LLNL) for western shales. For eastern shales, research is continuing on the KENTORT II process at the University of Kentucky and on the Pressurized Fluid Bed Hydrogen Retorting Process at the Institute for Gas Technology (IGT). At an earlier stage of research, work is in progress on the Recycle Oil Pyrolysis and Extraction Process at the Western Research Institute (WRI) and on Supercritical Fluid Extraction at Morgantown Energy Technology Center (METC).

The Hot Recycle Solids retort being developed by LLNL consists of a delayed fall combustor, a fluid bed gas block, a fluid bed mixer to mix combusted and raw shale, a moving bed retort with radial gas offtakes and a retorted shale transport lift pipe. LLNL has obtained encouraging results for this process and expects the costs to be less than for competing processes. They are seeking joint industrial support for future research in line with indications from Congress and DOE to move in that direction.

The KENTORT II process includes three fluid bed reactors:

- a pyrolysis reactor heated with gas from the gasifier
- a gasifier to reduce sulfur and buffer the retort from combusted shale
- a combustor as a heat source

The pressurized fluidized bed hydrogen retorting process uses finely ground beneficiated shale and increases oil yield by high pressure hydrogen retorting.

Laboratory R&D is directed at:

- defining coking and cracking kinetics at LLNL
- sulfur and nitrogen reactions at LLNL
- attrition and decrepitation properties at METC

Other laboratory research is directed at:

- identifying reaction mechanisms and defining their kinetics in slow and fast heat-up regimes at WRI
- pyrolysis at short residence time at METC
- conversion of beneficiated shales at METC and IGT

Environmental research is an important part of the DOE program, because environmental concerns may be potential show-stoppers for oil shale

utilization. Solid waste piles, for example, at commercial plants will have to be handled more responsibly in the future than has been done in some instances in the past.

DOE research in this area consists primarily of:

- spent shale pile modeling using indoor lysimeters at the U. of Wyoming
- remediation activities related to the Rock Springs site.

There is also research in our program to study utilization of products in higher valued end uses. These include:

- combusted shale for road bed stabilization at the U. of Wyoming
- improved asphalt from shale oil or additives from shale oil
- identification of the process streams and conditions needed to produce higher value products

We also have some ongoing international cooperation in oil shale research with both Australia and Israel.

Finally, there is also under development a plan, costing \$2.3 million funded half by Occidental Oil Shale Inc. \$400K by the State of Colorado and \$740K by DOE, for a proposed modified in situ demonstration facility. If the plan meets Occidental's expectations, they have indicated that they will propose a cost-shared project for a demonstration facility to be constructed and operated over a 10 year period.

DOE is continually assessing changes in the energy outlook and the effect on oil shale. There are two current developments which may have a significant impact over the next few years. In closing, I would like to briefly comment on each of these. First I would remind you of the importance of the National Energy Strategy. This strategy will be a document which Admiral Watkins, the Secretary of Energy, has indicated will be used to establish priorities within the Department. Recently the first part of the Strategy was published - this part summarizes the input received from a large scale effort to obtain public comment on energy options, problems and opportunities. Frankly, I find oil shale represented rather weakly in the work so far. As this Strategy is completed during the remainder of 1990, those interested in oil shale may wish to underscore the value and potential of this resource as a domestic liquid fuel source.

The second recent development is the publication of a National Research Council study, "Fuels to Drive Our Future", which compares various options for the production of domestic liquid transportation fuels. Along with the production of as much domestic petroleum as can be achieved, liquid fuels from oil shale and from direct coal liquefaction were rated as high priority options for the future. As a result of their analysis the NRC panel specifically recommended that DOE consider a coherent effort on advanced process development for Western oil shale. DOE is certain to take a closer look at shale R&D options - and those of you interested in shale development here in the West should probably consider carefully how you can provide the most and the best support for a new initiative.