value. Plans for mining and processing oil shale must aim not only at high recovery of the shale oil, but must take account of other resources and of the atmosphere as well, and work to preserve or restore their value.

Because of the existence of many unpatented mining claims, dating from before 1920, the title to some of the oil shale land is clouded. Aside from this land, the Federal government owns about 72 percent of the total oil shale acreage (78 percent in Colorado), and 79 percent of the estimated shale oil in place (82 percent in Colorado); depending on the resolution of clouded titles, Federal holdings may be a few percent larger in both acreage and oil. Even so, privately owned lands in Colorado contain 150–200 billion barrels of oil equivalent and known oil company holdings of 168,000 acres contain 31 billion barrels. Most of the privately-owned lands are either near the margins of the basin or along valleys where the oil shale crops out. Individual tracts lie in many different geologic and topographic environments and some of them may not be of a size or shape amenable to economic exploitation. Not all major oil companies or other parties interested in oil shale development own oil shale land, but recent sales indicate that private lands can be purchased for a few cents a barrel of oil equivalent in place. This low price per barrel is evident of the high cost of extracting and processing the material.

Oil shale is being mined and processed on a relatively small scale in a few foreign countries, and processes for retorting Colorado shale have been developed and carried to pilot-plant stage by the Bureau of Mines and the Union Oil Company of California. In the absence of full-scale development, production costs are not known but it appears that at best oil shale would be only marginally competitive with the petroleum industry today. For this reason and because capital costs are high and other sources of petroleum are now plentiful no commercial operations have been brought to fruition.

There is much evidence, however, of growing interest in oil shale in private industry, and there is widespread belief that technologic advance will bring production costs within competitive range. Eight companies have presently joined to support research at the Bureau of Mines installation at Anvil Points, Colorado; other companies are also undertaking technologic research; and the Federal government itself is continuing research that bears on oil shale technology.

In spite of the fact that the art of recovering shale oil is an old one, it seems to be still in its infancy, and many promising new approaches remain to be explored. The in-situ process, for example, under which oil would be formed and thermally driven from fractured ground without mining and without much, if any, effect on the land surface, is an especially promising process for recovering oil from the thicker and deeper parts of the basin. Considerable advance may be expected in oil shale technology. It should be noted, however, that several years lead time is required to develop a new industry *after* process development, so that even if technology were to advance rapidly it might be a decade before substantial production could be obtained.

Other factors besides the direct cost of production will also play a part in determining the point at which shale oil becomes competitive. The cost of conservation measures and the extent to which they must be directly borne by the industry, the availability and cost of oil and gas from other sources, and import and tax regulations all will help determine the price at which shale oil can be marketed profitably. Of these, the most critical is the cost of oil from other sources. Because oil shale can be made to yield either oil or gas, its place in the future energy mix depends on the extent to which it can compete economically with other sources of oil or gas. These include (1) undiscovered reservoirs of both oil and gas that may be found on further exploration; (2) oil remaining in known fields recoverable by secondary processes; (3) oil from foreign sources; (4) oil in tar sands and other bituminous rocks, particularly in Canada but also in the United States; and (5) oil and gas derived from the conversion of coal and other carbonaceous rocks. Each of these sources is potentially large, and the possibility of significantly enlarging production from them is being actively pressed by private industry.

Because of the availability of alternate sources of oil and gas, the case for oil shale development for the next few decades rests primarily on the economic benefit that would result if this large new source were to become available at competitive costs. That benefit however might be substantial, and significant other benefits might stem also from the increased geographic and physical diversity of energy sources.