



# Gauging the Prospects of a U.S. Oil Shale Industry

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Since the early 1980s, oil shale—sedimentary rock that contains solid bituminous materials that are released as petroleum-like liquids when the rock is heated—has not been on the U.S. energy policy agenda. But with oil prices hovering above \$60 per barrel and the demand for oil continuing to grow, interest in oil shale is also growing. In particular, oil shale is explicitly addressed in the Energy Policy Act of 2005. But the prospects for a viable oil shale industry are unclear; what knowledge we have is based on assessments that are clearly dated.

RAND Corporation research seeks to address this concern by providing an updated assessment.

## The Oil Shale Resource Base

The Green River Formation, which covers parts of Colorado, Utah, and Wyoming, has the largest known oil shale deposits in the world, holding from 1.5 to 1.8 trillion barrels of oil. Of that, roughly 800 billion barrels are recoverable—more than triple Saudi Arabia’s proven oil reserves. Present U.S. demand for petroleum products is about 20 million barrels per day, so 800 billion barrels would last for more than 400 years if oil shale could be used to meet a quarter of that demand.

## Oil Shale Technology Prospects

Two processing approaches are available for producing shale oil—mining followed by surface retorting and in-situ retorting. The current state of the art in mining appears to meet the requirements for commercially developing oil shale. The technical viability of surface retorting technology has been demonstrated, but large-scale testing will be required to develop scale-up information for first-of-a-kind commercial plants. As for costs, a first-of-a-kind commercial surface retorting complex is unlikely to be profitable unless real crude oil prices

## Abstract

Developing the nation’s massive oil shale resources would yield strategically significant benefits. Higher world oil prices and recent technological achievements are generating renewed interest in oil shale. Based on technical design needs, initial commercial operations are likely more than a decade away. Technological, economic, and environmental uncertainties are pervasive. To support permitting and land management decisions, government planning and preparatory efforts should begin as soon as there are clear indications of major private-sector investments toward commercialization.

are at least \$70–\$95 per barrel (2005 dollars) over the operating life of the plant.

As for in-situ retorting—heating oil shale in place and extracting it from the ground—Shell Oil Company has successfully conducted a small-scale field test based on slow underground heating using electric power. While larger-scale tests are needed, Shell anticipates that this in-situ method will be competitive at crude oil prices in the mid-\$20s per barrel.

A design base for a full-scale commercial surface retorting plant or an in-situ operation is at least six years away. Assuming the private sector decides to invest in oil shale development and production, we expect that an oil shale industry capable of producing more than a million barrels per day is at least 20 years off.

## Benefits of Shale Oil Production

Assuming a national production level of 3 million barrels per day, direct economic benefits in the

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\$20 billion per year range are possible, with roughly half going to federal, state, and local governments. Also, production at this level would likely cause oil prices to fall by 3 to 5 percent, saving American oil users roughly \$15 to \$20 billion annually.

A multimillion barrel per day industry would also yield a few hundred thousand jobs in the oil shale producing areas and in regions that contain industries that provide inputs to the production process.

As for national security, the principal value of oil shale production would be its contribution to a portfolio of measures intended to increase oil supplies, reduce oil demand, and weaken the geopolitical power of oil-exporting countries.

## Critical Policy Issues

Resolving environmental, socioeconomic, and key governance issues will determine whether there will be an oil shale industry in the western United States and how fast and how large that industry will grow.

- All known technical approaches will have *land-use and ecological impacts*, with impacts being especially severe for mining and surface retorting versus in-situ retorting using electric heating.
- Oil shale production will result in airborne emissions that could affect regional *air quality*, leading to a potentially stringent limitation on oil production levels. It may also lead to higher *greenhouse gas emissions* than conventional oil operations.
- Because all resources lie in the Colorado River drainage basin, *water quality* is an important issue. At present, not enough is known about how to prevent water contamination from surface and in-situ operations.
- Large-scale oil shale development will have *socioeconomic impacts*, stimulating significant regional population growth and likely stretching the financial abilities of local communities to provide needed public services.
- The richest, most abundant deposits are concentrated on federal lands, requiring that *leasing* be conducted using a strategic approach that balances environmental and land-use impacts against the benefits of strategically significant oil production levels.
- *Water consumption* in producing oil shale is about 3 barrels per barrel of oil. Earlier analyses of water availability for oil shale need to be updated based on current and expected demands for water from the Colorado River Basin.

## Key Recommendations

The future prospects for oil shale remain uncertain, and the government should refrain from major investments in oil shale

development until it receives a clear signal that the private sector is prepared to commit its technical, management, and financial resources. While awaiting that signal, a few low-cost efforts are appropriate:

- Oil shale should be added to the Department of Energy's research and development portfolio.
- A national oil shale archive should be established to hold and preserve information on oil shale resources, technologies, and impacts of development.
- Analyses should be conducted to address lease program implementation options that are well beyond the government's usual business model.

When private firms are willing to devote, *without appreciable government subsidy*, their resources to oil shale development, government decisionmakers should address the critical policy issues above. In particular, early action is warranted to:

- Develop and implement a research plan to establish options for mitigating ecological damage;
- Conduct research aimed at mathematically modeling the subsurface environment, along with a multiyear hydrological, geochemical, and geophysical monitoring program (if investments are for in-situ retorting);
- Conduct research aimed at establishing and analyzing options for long-term spent shale disposal (if investments are for mining/surface retorting);
- Model regional air quality to determine preferred locations for federal leasing and inform decisions on air quality permits for initial plants; and
- Develop a federal shale oil leasing strategy for the Green River Formation.

Many uncertainties about technology performance and environmental impacts are unresolved, and most of the critical issues will not be fully resolved until the initial round of large-scale commercial facilities are constructed and operated. Given this, oil shale development should proceed at a measured pace.

Because oil shale development could profoundly affect local residents and other stakeholders, the federal government should consider fostering the creation of a regionally based organization dedicated to planning, oversight and advice, and public participation. ■

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This research brief describes work done for RAND Infrastructure, Safety, and Environment documented in *Oil Shale Development in the United States: Prospects and Policy Issues*, by James T. Bartis, Tom LaTourrette, Lloyd Dixon, D.J. Peterson, and Gary Cecchine, MG-414-NETL (available at <http://www.rand.org/publications/MG/MG414/>), 2005, 87 pp., \$20.00, ISBN: 0-8330-3848-6. MG-414 is also available from RAND Distribution Services (phone: 310.451.7002; toll free: 877.584.8642; or email: [order@rand.org](mailto:order@rand.org)). The RAND Corporation is a nonprofit research organization providing objective analysis and effective solutions that address the challenges facing the public and private sectors around the world. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors. RAND® is a registered trademark.

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