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INVESTOR RISKS
from Oil Shale Development*

The Department of the Interior's Bureau of Land Management (BLM) recently proposed limiting federal leases for development of oil shale to Research, Development, and Demonstration (RD&D) leases instead of commercial leases. Given the many risks surrounding oil shale development, including technological uncertainties, regulatory risks, and water constraints, BLM's proposed RD&D approach makes sense. Investors should be similarly cautious in evaluating future investment in this technology.

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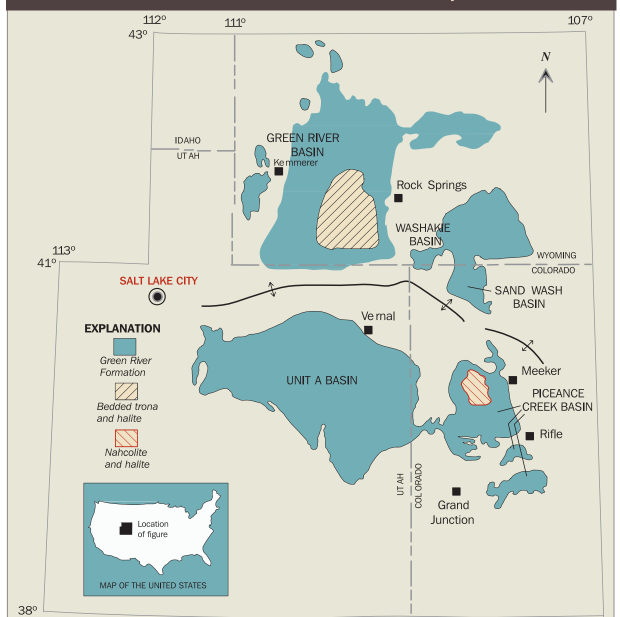
Background

Oil shale is a sedimentary rock that contains solid hydrocarbons in the form of kerogen, which is essentially immature petroleum. Due to its relatively shallow depth, the kerogen in the shale has not been subjected to enough heat and pressure to fully convert it into petroleum hydrocarbons.[1] The largest oil shale reserves in the U.S. are in the Green River Formation beneath Colorado, Wyoming, and Utah (see map). Estimates of the technologically recoverable oil there range from about 0.5 to 1.1 trillion barrels; to put that in context, the midpoint in that range (800 billion barrels) is more than triple the proved oil reserves of Saudi Arabia.[2] More than 70 percent of the Green River Formation oil shale resources lie beneath federal lands, primarily lands managed by BLM.[3]

Unlike conventional crude oil, the kerogen in oil shale is not liquid in its natural state and has to be heated through a process called "retorting" to separate it from the shale. There are two basic ways of retorting: surface methods involve mining and crushing the shale and heating it above-ground in a manner similar to conventional refining; *in situ* methods involve heating the shale while it is still in the ground and pumping the resulting hydrocarbons to the surface.[4]

Green River Formation Oil Shale Deposits



Source: Dyni, USGS, 2006

Oil shale technology is still in the early stages of development, even though it has been recognized as a potential U.S. energy resource since the mid-1800s. Sporadic attempts to commercialize oil shale during periods of high oil prices or heightened concerns about energy security repeatedly failed once oil prices fell again.[5]

As oil prices and energy security concerns have risen again over the past decade, there has been renewed interest in oil shale. In 2005, BLM initiated an RD&D program for companies to test oil shale technologies and their impacts, resulting in the issuance of six RD&D leases for oil shale projects on federal lands. Three additional projects are currently under environmental review from a second round of BLM RD&D lease solicitations in 2009.[6] Several other oil shale projects are under development on state and private lands. *(See table on next page)*

In 2008, BLM issued a plan to lease larger amounts of federal land—more than two million acres—for commercial oil shale development, which was legally challenged by environmental organizations. As part of the ensuing settlement, BLM agreed to take a fresh look at the plan in 2011. The recent draft Programmatic Environmental Impact Statement that BLM prepared as part of this process recommended leasing smaller amounts of land—just under 462,000 acres—only for RD&D "so as to obtain more information about the technological requirements for development of this resource, as well as the environmental implications, before committing to broad-scale commercial development."[7] Because there are still many unknowns about the technologies that may be used for commercial development of oil shale, the RD&D approach to leasing is prudent.

Likewise, investors considering investment in the development of oil shale should be sure to obtain a comprehensive understanding of the wide range of risks that these projects could present.

Key Investor Risks from Oil Shale Development

Investors face risks from oil shale exposure through their public equity investments in oil companies and their holdings in related companies. They may also face risks through private equity and other forms of development capital. Investor exposure can be difficult to assess, due to limited disclosure from the companies involved. To get a sense of some of the figures in play, Exxon spent $1 billion on failed oil shale development efforts in the 1970s and early 1980s (Exxon pulled out in May 1982 when oil prices began to decline and newly discovered less-costly reserves came online),[8] and Shell's recent agreement to develop oil shale in Jordan is projected to cost $20 billion or more over that project's first two decades.[9]

Investors should be aware of the range of risks that oil shale development efforts face, which could potentially lead to stranded assets and reduced shareholder returns.

››› Core Technological Uncertainty

Oil shale technology is still in the early stages of development, particularly *in situ* processes. Surface retorting technology has not been applied successfully in the U.S. at a commercially viable level, and though the technology has been in development for several years, further development and testing is required.[10] The uncertainties around continued testing and development of new technologies and processes for producing oil from oil shale leave a great deal still unknown, including the amount of the resource that is recoverable, the efficiencies and costs of various methods, the impacts on natural resources, and the effects of various technologies on the costs of final products (and thus the competitiveness of oil shale).[11] It is primarily this uncertainty that led BLM to recommend making acreage available only for RD&D leases.[12] And this uncertainty creates risk for investors. As the Task Force on Strategic Unconventional Fuels (comprised of federal, state, and local officials) put it, "[d]emonstration of first-generation technologies will be required at a commercially-representative scale before significant private investment will lead to commercial production."[13] The Task Force further explained that "[t]echnology uncertainty is the largest single risk factor associated with oil shale development. This uncertainty remains even after 50 years of government and industry research to develop a commercially viable retorting technology."[14]

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››› Regulatory Risks

Current and future regulations may pose serious risks to oil shale. Lifecycle carbon emissions for fuels derived from oil shale are likely to be 25 to 75 percent greater than for conventional petroleum fuels, depending on the process used.[15] Assuming the estimates of elevated CO_2 emissions for oil shale are reaffirmed and verified, then development of these fuels could face risks from regulations such as:

- ***lifecycle emissions requirements*** (e.g., Section 526 of the Energy Independence and Security Act of 2007, which prohibits federal agencies from procuring "alternative or synthetic fuel" unless its lifecycle greenhouse gas emissions are less than or equal to conventional fuels);[16]
- ***clean fuel standards and low carbon fuel standards*** that aim to regulate and reduce the lifecycle carbon intensity of transportation fuels (e.g., the LCFS adopted by California in 2009, though it is currently being challenged in court);[17] and
- ***legislation that puts a price on carbon***, which, while unlikely in the near term, remains a possibility in the longer term.

Given its high carbon intensity, oil shale will be very dependent on carbon capture & sequestration (CCS) if it is to survive and thrive as carbon-reducing regulations take hold. In addition to being very expensive, CCS faces many uncertainties—including with respect to its commercial viability, public opposition, enabling policies, carbon price levels, public financing needs, and constraints on markets for captured CO_2.

Other federal and state environmental regulations, including those related to air and water quality, may pose additional risks to oil shale development. For instance, oil shale operations will produce a range of air pollutants (both criteria pollutants and air toxics) covered by the Clean Air Act (CAA). The CAA's Prevention of Significant Deterioration (PSD) regulations might constrain oil shale development in the Green River Formation and elsewhere, particularly where oil shale resources are near or immediately upwind of "Class I" areas of natural or scenic value where incremental increases in air pollution are strictly limited. Furthermore, if the oil shale industry reaches the stage of applying for PSD permits, and those permits are based on use of Best Available Control Technology (BACT), it is possible that the first few facilities will exhaust the total PSD increment allowed for the region.[18]

Some Oil Shale Projects & Leases in the United States

Company	State	Lease Type
American Shale Oil LLC (AMSO)	CO	BLM 1st Round
Anadarko Petroleum Corp.	WY	Private
AuraSource, Inc.	UT	Applied for BLM 2nd Round
Red Leaf Resources, Inc.	UT	Private & State
EnShale, Inc.	UT	State
Exxon Mobil	CO	Private & Applied for BLM 2nd Round
Great Western Energy, LLC	UT	State
Independent Energy Partners	CO	Private
Millennium Synfuels, LLC	UT	State
Natural Soda Inc.	CO	Applied for BLM 2nd Round
Enefit American Oil (acquired OSEC in 2011)	UT	BLM 1st Round, Private, & State
Shell Exploration and Production Co.	CO	Private & BLM 1st Round (3)

››› Market Risks

The economic competitiveness of oil shale is contingent on several market factors, including high up-front expenditures and long payback horizons. As the Task Force on Strategic Unconventional Fuels noted, production of oil shale is "characterized by high capital investment, high operating costs, and long periods of time between expenditure of capital and the realization of production revenues and return on investment." Further, the significant uncertainties about the size of capital and operating costs for a first-generation commercial facility (likely in the billions of dollars), combined with oil price volatility and other uncertainties, "pose investment risks that make oil shale investment less attractive than other potential uses of capital."[19] As noted earlier, sporadic attempts to commercialize oil shale have repeatedly failed once oil prices fell again.[20] To get a sense of the payback horizons, consider that the Congressional Budget Office explained in February 2012 that it "does not expect that the federal government would receive any significant royalty payments until after 2022" from commercial oil shale development,[21] while the Energy Information Administration's 2011 *Annual Energy Outlook* projects that oil shale production under the Reference (i.e., business-as-usual) case will first come online in the Rocky Mountain region in 2029.[22]

Oil shale should not be confused with "shale oil", which involves typical crude oil that is trapped in relatively non-permeable shale rock, such as the Bakken Shale in North Dakota.

››› Water Constraints

Oil shale development may be constrained by the technology's need for large amounts of water. This is a particular concern for oil shale production in water-stressed states such as Colorado and Utah. Estimates vary widely, but water needs for oil shale may be anywhere from 2 to 4 barrels of water for every barrel of product produced via surface retorting and anywhere from 1 to 12 barrels of water per barrel of product produced via *in situ* methods.[23] The U.S. Government Accountability Office has suggested that the size of the oil shale industry in Colorado and Utah may be limited by water availability.[24] The general scarcity of water in regions where the deposits are located can also lead to significant public opposition to oil shale development plans, potentially leading to delays or other hurdles.[25] Rising populations in the region have led to increasing water demand for electric power, recreational use, and ecosystem restoration, while extended droughts have reduced river flows, suggesting that "[s]ignificant water withdrawals to supply an oil shale industry may conflict with other uses downstream and exacerbate current water supply problems."[26]

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››› Risks from Public Opposition

CCS projects in places such as Ohio, New York, and Germany have faced strong public opposition that complicated or derailed the projects.[27] Public opposition to development of oil shale—based on the actual or perceived environmental impacts on land, air, water, or the global climate[28]—could similarly derail, delay, or increase the costs of such projects. This public opposition may at times take the form of litigation, such as the lawsuit by environmental groups challenging BLM's oil shale leasing plans.[29]

KEY RECOMMENDATIONS FOR INVESTORS

Each of the factors above, as well as others, may independently carry considerable weight in any risk/reward investment decision concerning oil shale development. Cumulatively, the factors may give pause to many investors. Given the wide range of risks, investors should:

- ***Analyze their equity investments and engage with relevant companies*** (e.g., oil and gas companies, end users) in which they are shareholders, to further understand the risks companies are assuming related to oil shale and the ways in which companies are mitigating those risks.
- ***Pay close attention to the potential for risks*** to emerge in their fixed income portfolios from state and municipal bonds, to the extent such bonds are used to directly or indirectly support development of oil shale (e.g., infrastructure finance).[30]
- ***Advocate for public policies*** that create a clearer low-carbon regulatory framework and provide long-term investment certainty.

Endnotes

* This fact sheet is based on Ceres' December 2010 report *Investor Risks from Development of Oil Shale and Coal-to-Liquids*, http://www.ceres.org/resources/reports/oil-shale-coal-to-liquids/view

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