RAND INFRASTRUCTURE, SAFETY, AND ENVIRONMENT

Costs and Benefits of Oil Shale Development

James T. Bartis

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RAND Focus is on Three Questions

- **What are the prospects for oil shale development?**
- **What is the strategic significance for the U.S. of developing a domestic oil shale industry?**
- **What are the critical policy issues surrounding the prospect of oil shale development?**

The Bigger Energy Picture

- **Oil production**
  - **Global liquids production: 85 million barrels per day**
  - **U.S. liquids consumption: 19 million barrels per day**
  - **U.S. imports: 10 million barrels per day**
- **Problems with oil**
  - **Costs too much**
  - **Supplies are not secure**
  - **Causes environmental damage**
  - **Releases greenhouse gases**
- **But alternatives are limited**
  - **Many biomass resources are not climate-friendly**
  - **Greatest potential is efficiency and electrification**

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Many experts believe that global production of conventional oil will peak in the 2020 to 2035 timeframe

Questions and Answers

Question	Answer
• What are the prospects for oil shale development?	• Massive resources but costly to extract; technology advances are promising, but decades before there could be significant production
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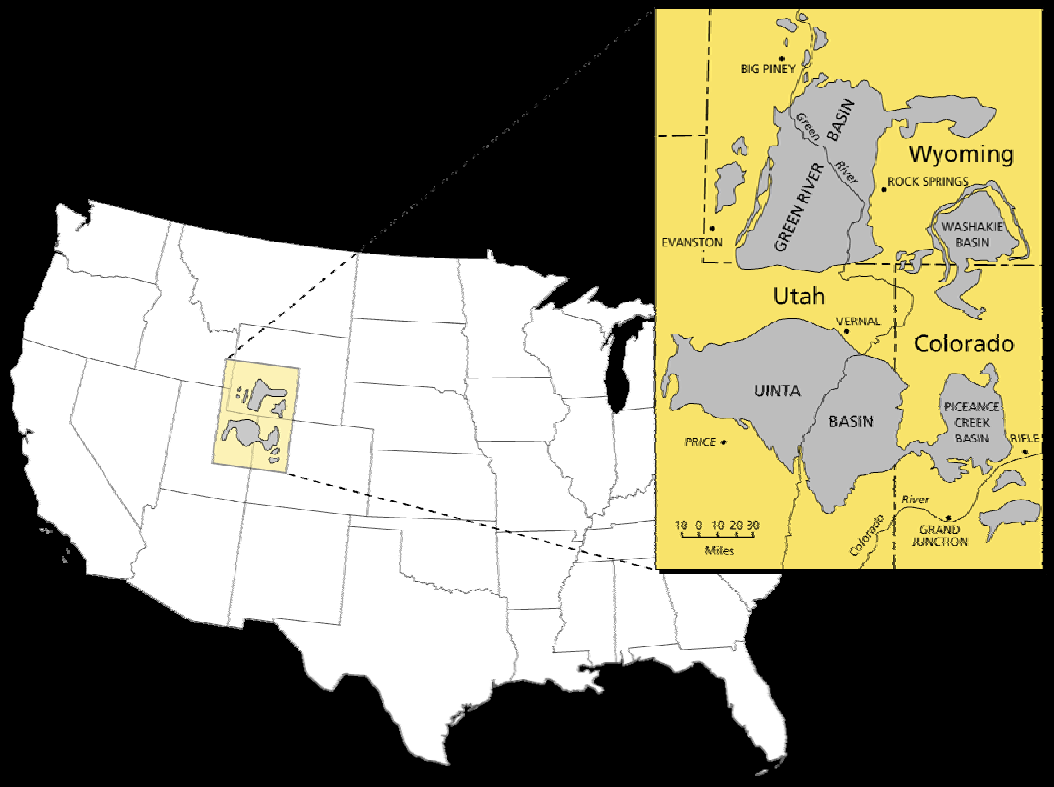
Colorado Will Be the Focus of Early Development

- Green River Formation has largest deposits in the world
  - Estimates are of 1.5–1.8 trillion barrels in place
- Recoverable estimates are very high
  - Upper bound: 1.1 trillion
  - Lower bound: 500 billion
  - Midpoint: 800 billion
- Present U.S. demand for oil is about 20 million bpd
- If oil shale could be used to meet 1/4 of demand, 800 billion barrels would last over 400 years

Green River Formation



The Development Timeline Is Long

Development Stage	R&D	Scale-up and Confirmation	Initial Commercial Operations	Production Growth	
Facility Size	Laboratory to Pilot Plant	1,000–5,000 bpd	>50,000 bpd	>100,000 bpd	
Years to Transition*	0	6–8	12–16	>20	>30
Total Production (million bpd)	N/A	N/A	>0.1	>1	>3

*Beginning with the transition from R&D. N/A=not applicable; bpd=barrels per day.

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• What is the strategic significance for the U.S. of developing a domestic oil shale industry?	• Large economic gains, lower oil prices, new jobs, and geopolitical benefits
• What are the critical policy issues surrounding the prospect of oil shale development?	

Economic Benefits Include Economic Profits, Employment Benefits, Reduced Oil Prices

Assuming production of 3 million barrels/day

Economic Profits	• **Maybe tens of billions of dollars per year in profits** • **About half will go to federal, state, local governments via lease bonus payments, royalties on production, and corporate income taxes**

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Reduce World Oil Prices	• **World oil prices would be likely to fall 3–5%** • **Benefits to U.S. consumers would likely be $10–25 billion per year**

National Security Benefits Derive from Lower World Oil Prices and Increased Supplies

- **High world oil prices and tight supplies increase geopolitical leverage of oil-exporting countries to:**
  - **Pursue policy goals that run counter to U.S. interests**
  - **Purchase weapons or develop own industrial base for munitions manufacture**
  - **Assist large terrorist organizations**
- **Principal value of oil shale would be its role in a portfolio of measures to increase oil supplies and decrease demand**

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• What are the critical policy issues surrounding the prospect of oil shale development?	• Resolving technical, environmental, governance issues will determine whether and how quickly a strategically significant industry will develop

Oil Shale Industry Will Have Environmental and Socioeconomic Impacts

Land Use	• Major land use and ecological impacts; surface retorting more than in-situ conversion
Air Quality	• Early plants could prevent future growth; available studies from 1980s are no longer relevant
Climate Change	• Will entail significantly higher CO2 emissions compared to conventional oil operations; controlling them will lead to slightly higher costs
Water Quality	• All resources lie in Colorado River drainage basin • Issue is leaching of salts/toxics from spent shale or after underground extraction operations cease
Socio-economic	• Will stimulate significant population increases in area, which will likely stretch financial ability to provide needed public services

Several Challenges Currently Constrain and/or Limit Commercial Production

Production Costs	• Nobody knows until they build a pioneer facility
Market Risks	• Investments deferred until enough safety cushion between production costs and what market will pay
Leasing of Federal Lands	• Richest/most abundant deposits on Federal lands • Normal leasing approach of BLM will not work—e.g., too many near-neighbor problems • Must address public/private sector equity issues
Water Consumption	• 3 barrels of water needed for each barrel of shale oil • Nearer term issue: local water supply infrastructure • Bigger issue: Other demands for water from greater Colorado River Basin; 1980s analyses outdated

Challenges for Oil Shale Development

- **Providing incentives for pioneering firms**
  - **Low royalty payments, tax incentives**
- **Protecting the public interest in oil shale**
  - **Much higher royalty payments as technical risks decrease**
- **Governance of intensive development in a compact area**
  - **How can the public get reliable information?**
  - **How can multidimensional environmental oversight be implemented?**
  - **What is the mechanism to balance local, state, and federal interests?**
  - **Is a "port authority" approach appropriate?**

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In-Situ Conversion May Be Viable and Its Costs Are Very Promising

Approach	Technical Viability/Commercial Readiness	Costs
Mining and Surface Retorting	• Current state of the art in mining can support oil shale development • Technical risks are low, but major scale-up issues for initial commercial plants—requires large-scale testing	$70–$95 per barrel
In-Situ Conversion	• Small-scale testing indicates process may be technically/economically viable • But confirmation requires controlling groundwater during production and preventing subsurface environmental problems	??? maybe below $50 per barrel