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The Promise and Peril of Oil Shale Development
(February 5)

2010

2-5-2010

SLIDES: Costs and Benefits of Oil Shale Development

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Citation Information

Bartis, James T., "SLIDES: Costs and Benefits of Oil Shale Development" (2010). *The Promise and Peril of Oil Shale Development (February 5)*.

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INFRASTRUCTURE, SAFETY,
AND ENVIRONMENT

***Costs and
Benefits of
Oil Shale
Development***

James T. Bartis

February 2010



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

Are We Running Out of Oil?

“Secretary predicted today a serious shortage of crude oil within a year and exhaustion in fourteen to twenty years...”

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– At least 5 outbreaks since 1880

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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

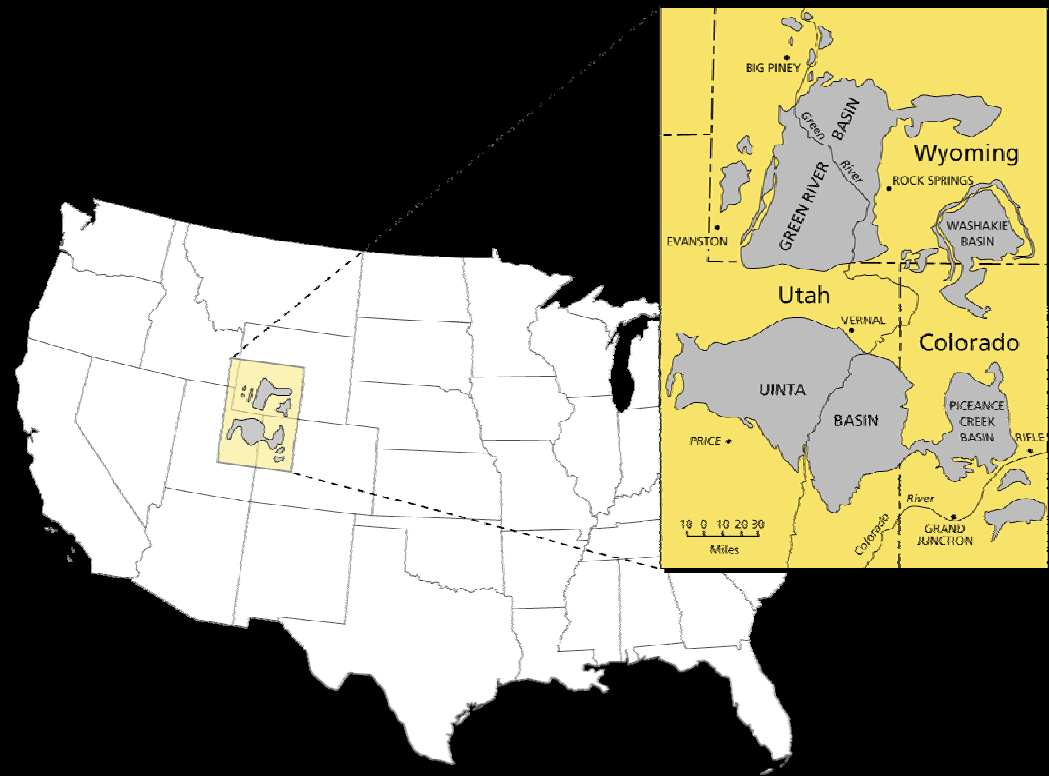
Answer

- **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**
- **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?**

Colorado Will Be the Focus of Early Development

Green River Formation

- 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



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.

Questions and Answers

Question

Answer

- 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?
- Massive resources but costly to extract; technology advances are promising, but decades before there could be significant production
 - Large economic gains, lower oil prices, new jobs, and geopolitical benefits

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

Assuming production of 3 million barrels/day

Economic Profits	<ul style="list-style-type: none">• 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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Employment Benefits	<ul style="list-style-type: none">• Few hundred thousand jobs created, either directly or indirectly associated with shale oil• Net job effect depends on where alternative investments would be made

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Employment Benefits	<ul style="list-style-type: none">• Few hundred thousand jobs created, either directly or indirectly associated with shale oil• Net job effect depends on where alternative investments would be made
Reduce World Oil Prices	<ul style="list-style-type: none">• 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**

Questions and Answers

Questions

- What are the prospects for oil shale development?
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Answer

- Massive resources but costly to extract; technology advances are promising, but decades before there could be significant production
- Large economic gains, lower oil prices, new jobs, and geopolitical benefits
- 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	<ul style="list-style-type: none">• Major land use and ecological impacts; surface retorting more than in-situ conversion
Air Quality	<ul style="list-style-type: none">• Early plants could prevent future growth; available studies from 1980s are no longer relevant
Climate Change	<ul style="list-style-type: none">• Will entail significantly higher CO2 emissions compared to conventional oil operations; controlling them will lead to slightly higher costs
Water Quality	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• Nobody knows until they build a pioneer facility
Market Risks	<ul style="list-style-type: none">• Investments deferred until enough safety cushion between production costs and what market will pay
Leasing of Federal Lands	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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