SLIDES: Costs and Benefits of Oil Shale Development

James T. Bartis

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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
“Secretary predicted today a serious shortage of crude oil within a year and exhaustion in fourteen to twenty years…”
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New York Times: 26 June 1943
Are We Running Out of Oil?

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COAS: Crude oil anxiety syndrome (aka: Peak Oil)
   – 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
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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
### The Development Timeline Is Long

<table>
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<tr>
<th>Development Stage</th>
<th>R&amp;D</th>
<th>Scale-up and Confirmation</th>
<th>Initial Commercial Operations</th>
<th>Production Growth</th>
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<tr>
<td>Facility Size</td>
<td>Laboratory to Pilot Plant</td>
<td>1,000–5,000 bpd</td>
<td>&gt;50,000 bpd</td>
<td>&gt;100,000 bpd</td>
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<tr>
<td>Years to Transition*</td>
<td>0</td>
<td>6–8</td>
<td>12–16</td>
<td>&gt;20</td>
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<tr>
<td>Total Production (million bpd)</td>
<td>N/A</td>
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<td>&gt;0.1</td>
<td>&gt;1</td>
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*Beginning with the transition from R&D.  N/A=not applicable; bpd=barrels per day.*
## Questions and Answers

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## 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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Economic profits could be significant, with maybe tens of billions of dollars per year. About half of these profits would go to federal, state, and local governments via lease bonus payments, royalties on production, and corporate income taxes. This would have substantial economic benefits and reduced oil prices, assuming a production of 3 million barrels per day.
### Economic Benefits Include Economic Profits, Employment Benefits, Reduced Oil Prices

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<td>Employment Benefits</td>
<td>Few hundred thousand jobs created, either directly or indirectly associated with shale oil</td>
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<td>• Net job effect depends on where alternative investments would be made</td>
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Reduce World Oil Prices

- World oil prices would be likely to fall 3–10%, but depends on future OPEC behavior
- Assuming a 3–5% drop, benefits to U.S. consumers would likely be $15–45 billion per year
### Economic Benefits Include Economic Profits, Employment Benefits, Reduced Oil Prices

**Assuming production of 3 million barrels/day**

| Economic Profits | • 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 |
| Employment Benefits | • 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 | • 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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<td>• Resolving technical, environmental, governance issues will determine whether and how quickly a strategically significant industry will develop</td>
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Oil Shale Industry Will Have Environmental and Socioeconomic Impacts

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<th>Land Use</th>
<th>• Major land use and ecological impacts; surface retorting more than in-situ conversion</th>
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<td>Air Quality</td>
<td>• Early plants could prevent future growth; available studies from 1980s are no longer relevant</td>
</tr>
<tr>
<td>Climate Change</td>
<td>• Will entail significantly higher CO2 emissions compared to conventional oil operations; controlling them will lead to slightly higher costs</td>
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| 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

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<th>Category</th>
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<td>Production Costs</td>
<td>• Nobody knows until they build a pioneer facility</td>
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<td>Market Risks</td>
<td>• Investments deferred until enough safety cushion between production costs and what market will pay</td>
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| 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?
**In-Situ Conversion May Be Viable and Its Costs Are Very Promising**

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<tr>
<th>Approach</th>
<th>Technical Viability/Commercial Readiness</th>
<th>Costs</th>
</tr>
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| 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 |