DOE Office of Petroleum Reserves – Strategic Unconventional Fuels

Fact Sheet: U.S. Oil Shale Economics

Economic Requirements for Oil Shale Feasibility

- Oil shale technologies must be demonstrated at commercial scale before definitive capital and operating costs of oil shale projects will be known.
- Oil shale projects must demonstrate capability to achieve a minimum rate of return at expected sustained average world oil prices.

What are the Major Cost Elements of Oil Shale Projects?

For Mining and Surface Retorting:

- Mine development: surface or underground
- Retorting & upgrading facilities: design, manufacture, and construction of facilities
- Infrastructure: roads, pipelines to upgrading plants and refineries, powerlines, utilities, storage tanks, waste treatment and pollution control.

For In-Situ (underground) Processing:

- Subsurface facilities: wells or shafts to access and heat the shale, recover liquids and gases, and isolate and protect subsurface environments.
- Surface facilities: production pumps and gathering systems, process controls, process power, and upgrading facilities.

How Big is a Commercial Scale Project?

- Commercial oil shale projects could range in size from 10,000 to 50,000 barrels per day for surface retorts to as much as 300,000 barrels per day for full-scale in-situ projects.

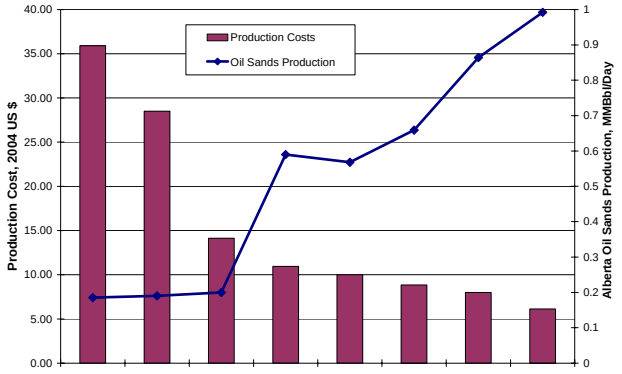
How Much Will Commercial Projects Cost?

- Cost estimates will vary according to the oil shale resource and the process selected. In the 1980s, cost estimates for a 100,000 barrel/day surface retort plant ranged from $8 - $12 billion (2005$)[1]. Capital costs are expected to be less today, i.e., $3.0 to $10.0 billion (2005$).

Can Costs be Expected to Decrease Over Time?

- Yes. Capital and operating costs can be expected to decrease over time with operating experience, improved understanding, design enhancements, and improved operating efficiencies, analogous to the experience of the Province of Alberta in developing its oil sands resources.

Figure 1 – Canadian Oil Sand Economics and Production



Production Costs: Oil & Gas Journal, July 14, 2003, V. 101.27
Production Volumes: Canadian Association of Petroleum Producers, Historical Statistics

- Production costs in Alberta's oil sands declined by as much as 80 percent between 1980 and 2003. Oil shale cost reductions of 40 to 50 percent could occur as lessons from first of a kind facilities are learned and applied (Figure 1)[2].
- Mining capital costs have risen with the trend toward more mechanized mining operations. Mine operating costs have decreased significantly as mining efficiency has improved.
- Rapid industry growth may tax limited resources of skilled labor, materials, and manufacturing facilities for retorting technologies and mining and processing equipment, increasing costs.

What Sustained Oil Prices are Required for Oil Shale Projects to be Economic?

- First of a kind mining and surface retorting plants may eventually be economic, providing a minimum 15% rate of return, at sustained average world oil prices above $54.00 per barrel.
- In-situ processes may be economic at sustained average world oil prices above $35 per barrel.

What are the Potential Public Economic Benefits of Oil Shale Development?

- The Federal treasury, State and local governments, and the overall domestic economy stand to benefit from the direct contributions of a domestic oil shale industry and from the additional economic activity and growth that will result from industry development.
- Direct benefits can be measured in terms of: (1) Direct Federal revenues (from lease bonuses, Federal taxes and the Federal share of royalties) (2)

Direct state/local revenues (from State and local taxes and the state share of Federal royalty); (3) Contributions to Gross Domestic Product (GDP), and (4) the value of avoided oil imports.

- At a sustained production of about 2.5 million barrels of shale oil per day, the cumulative value of these benefits over a 25 year period could exceed $500 billion.

With Oil Prices at $60/ Bbl, What are the Impediments to Investment in Oil Shale?

- Large initial capital requirements
- Insufficient private tracts of high-grade oil shale
- Restricted access to resources on public lands
- Oil price uncertainty and volatility
- Technology not demonstrated at commercially-representative scale
- Competing investment opportunities, including investments in other conventional and unconventional oil and gas resources

How Have Current Oil Shale Economics Been Modeled by DOE?

- DOE has performed an analysis of the economics of oil shale. DOE developed a model to evaluate project economics for the application of oil shale technologies to selected resource tracts, and the impacts of various incentives on project economics.
- As there are no commercial facilities currently operating in the United States, capital cost and production cost data used in the analyses were updated from past technology processes and from current vendor cost information to construct plausible cost scenarios.
- The analysis applied resource characterization data from surveys conducted by the U.S. Geological Survey in preparation for the 1974 Prototype Oil Shale Leasing Program.
- The economic analysis examined 27 USGS defined resource tracts, which were nominated by industry, to determine the most efficient technology approach for use at each location.
- The production cost and resource characterization data were then used to calculate minimum economic prices.
- The minimum economic price is defined as the breakeven price assuming a return on capital of 15 percent, and represents our best cost estimates for a mature industry.
- These cost estimates do not take into account research and development costs, permitting costs, land access issues, or production inefficiencies that are characteristic of first-of-a-kind plants. All of these other factors could add significantly to early development costs and have the potential to double production costs for the first plants.
- The model estimates cash flow for the various projects by evaluating plant capacity, development schedule, market prices for oil and natural gas, leasing royalty structure, operating costs, capital costs, and tax structure.
- The model determines the minimum economic cost shown and breakeven prices for a given technology for each resource tracts where it is being applied.
- Capital costs are the sum of investments needed per barrel of installed capacity. These costs include investments in mining, retorting, solid waste disposal, refining and upgrading, plant utilities, and other facilities.
- Operating costs include fuel, operating and maintenance personnel, consumable equipment and other non-capital costs for mining, retorting, refining and upgrading,
- The components of both capital and operating costs are different for various technologies used for mining, retorting, and upgrading. These costs were derived from information available from a variety of sources, particularly the Prototype Leasing Program in the early 1980's. These costs were escalated to 2004 dollars using Bureau of Labor Statistics data and were further validated with current vendor quotes.

References

[1] U.S. Office of Technology Assessment. "An Assessment of Oil Shale Technologies", 1980.
[2] Oil and Gas Journal, July 13, 2003.