DOE Office of Petroleum Reserves – Strategic Unconventional Fuels

Fact Sheet: U. S. Tar Sands Potential

Background

- Tar sands (referred to as oil sands in Canada) are a combination of clay, sand, water, and bitumen, a heavy, black, asphalt-like hydrocarbon.
- Bitumen from tar sands can be upgraded to synthetic crude oil and refined to make asphalt, gasoline, jet fuel, and value-added chemicals.
- U.S. tar sands tend to be lean and the mineral matter consolidated (sand grains are cemented together with minerals). While lessons may be learned from the experience in Alberta, modifications in those technologies may be necessary to cost-effectively produce synthetic oil from U.S. tar sands.

U.S. Tar Sand Resources

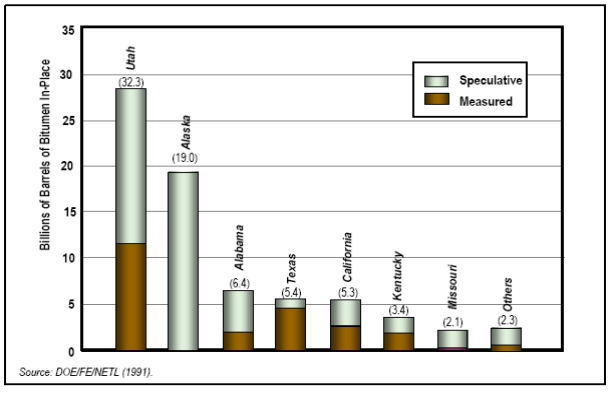
- U.S. tar sands resources are estimated at 60 to 80 billion barrels of oil; some 11 billion barrels may be recoverable[1]. The resource could support 500 M Bbl/d of production. The richest deposits are found in Utah (Table 1) and California.
- Current access, technology, and investment constraints make near-term production unlikely.
- Government action and incentives could catalyze an industry of 350,000 Bbl/d by 2035.

Table 1 - Utah Tar Sands Resources (MMBbl)

Deposit	Known Resource	Additional Potential
Sunnyside	4,400	1,700
Tar Sand Triangle	2,500	13,700
PR Spring	2,140	2,230
Asphalt Ridge	820	310
Circle Cliffs	590	1,140
Other	1,410	1,530
Total	**11,860**	**20,610**

Source: DOE/FE/NETL (1991)

Figure 1 – Distribution of U.S. Tar Sands



Tar Sands Technology

- Recovery technology options depend on grade, viscosity and depth. Shallow, colder resources are more viscous, but may be surface mineable.
- Deeper, warmer resources are less viscous, but may require in-situ processes to produce.
- Steam injection, including Steam Assisted Gravity Drainage (SAG-D), has been the favored in-situ method in Alberta;
- Other processes include solvent vapor, THAI, or Cold Heavy Oil Production with Sand (CHOPS).
- Bitumen may be separated from the sands by hot-water or cold-water or hot-water extraction processes, depending on the composition of the resource.
- But neither may work on U.S. tar sands that are "oil-wet", and consolidated.
- New technology solutions or adaptations of those used in Alberta may be necessary to produce oil from U.S. tar sands.
- About two tons of tar sands yield one barrel of oil - roughly 90 % of the bitumen is recovered.

Figure 2 – Cyclic Steam Injection

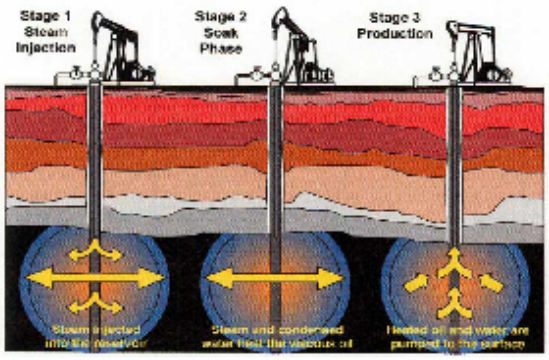
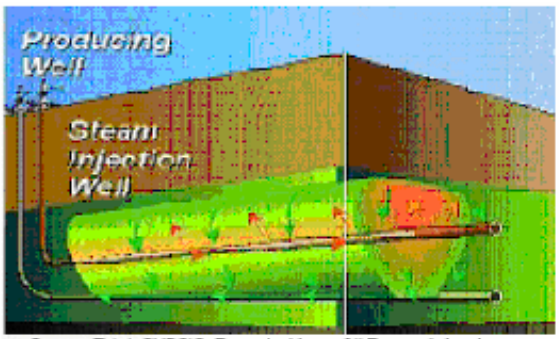


Figure 3 – Steam Assisted Gravity Drainage



Source: Total, CUPCIC, Francois, Heavy Oil Research Leader

Tar Sands Economics

- U.S. tar sands production costs are expected to be similar to or higher than costs in Alberta
- Costs may be higher as technologies are tailored to meet the characteristics of U.S. tar sands.
- Alberta oil sands costs declined steadily as lessons learned made project design, construction and operations more efficient.
- Projects require large capital investments. Capital costs depend on the production technology chosen. Mining is more capital intensive than alternative in-situ processes. (Table 2)
- Recently, capital and operating costs for Alberta oil sands projects have increased due to increased demand and tight supplies of skilled labor and construction materials. (Table 3)

Table 2 - Capital Costs of Tar Sands Projects in Canada ($2006 USD)

Project Type	Cost per Barrel of Daily Capacity
Integrated mining, extraction and upgrading	$37,940
Mining and extraction	$17,070
Steam Assisted Gravity Drainage (SAG-D)	$11,380
Cyclic Steam Soak (CSS)	$17,070

Source: National Energy Board of Canada, An Energy Market Assessment, 2004. Costs converted to U.S. dollars and escalated to 2005 by INTEK, Inc.

Table 3 - Alberta Oil Sands Costs / Barrel ($2006 USD)

Process / Technology	Product	Operating Costs ($/Bbl)	Total Supply Cost** ($/Bbl)
Cold Production	Bitumen	4-7	9-13
Cold Heavy Oil Production with Sand	Bitumen	6-9	11-15
Cyclic Steam Stimulation	Bitumen	8-13	12-17
Steam Assisted Gravity Drainage	Bitumen	8-13	10-16
Mining / Extraction	Bitumen	6-9	11-15
Integrated Mining / Upgrading	Syncrude	11-17	21-27

** Total Supply Cost includes capital and operating expenses.

Source: National Energy Board of Canada, An Energy Market Assessment, 2004. Costs converted to U.S. dollars and escalated to 2005 by INTEK, Inc.

Markets for Oil from Tar Sands

- Bitumen from tar sands produced in Utah would be refined in PADD IV.
- PADD IV refining capacity (600 M Bbl/d, projected to double by 2025) could fully absorb potential Utah syncrude production if expanded.
- Refineries in the region now process 555 M Bbl/d of crude; 260 M Bbl/d from Canada.
- Utah tar sands must compete with Alberta syncrude for market share on a $/bbl basis

Tar Sands Environmental Data

Emissions

- Bitumen and syncrude manufacture produces a slate of gases that includes carbon dioxide, sulfur dioxide, and nitrous oxides.
- Technology is available to control and reduce emissions. Scrubbers on coking units can reduce sulfur emission to acceptable levels, given the bitumen is low in sulfur (~0.6 %) to begin with.

Land Disturbance

- The area of disturbance depends on mining versus in-situ processing. A 50 M Bbl/d surface operation would require 10,000 acres. Land can later be reclaimed with cleanup and rejuvenation efforts.

Water Impacts

- Depending on the process, a large volume of water may be needed to extract and process tar sands and bitumen, albeit because of favorable mineral composition, less than the 3 bbl/bbl current used in Alberta.
- Use of substantial volumes of water could affect regional water supplies.
- The release of treated water, could affect the regional water quality and supply.

References

[1] International Centre for Heavy Hydrocarbons, 1993 U.S. Bitumen Database, http://www.oildrop.org.