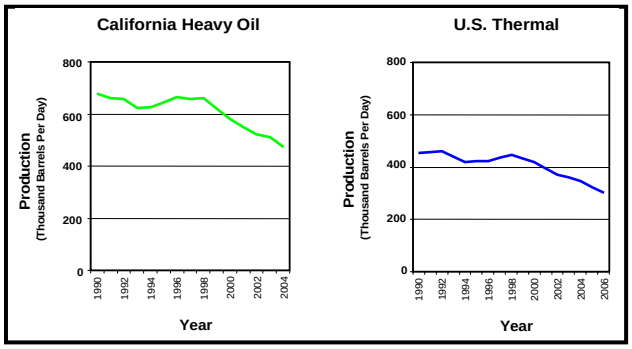
DOE Office of Petroleum Reserves – Strategic Unconventional Fuels

Fact Sheet: U.S. Heavy Oil Resource Potential

Background

- "Heavy oil" is a dense, viscous crude oil that has an API gravity between 10 and 20 degrees.
- Most heavy oil has a viscosity between 100 and 10,000 centipoise (cp), and does not flow readily in the reservoir without dilution (with solvent) and/or the introduction of heat.
- Currently heavy oil production and other thermal EOR production are in decline. (Figure 1)

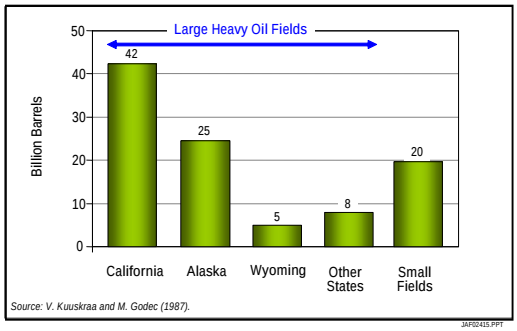
Figure 1 - California Heavy Oil and Thermal EOR Production are Declining[1]



U.S. Heavy Oil Resources

- The U.S. heavy oil resource approaches 100 billion barrels of original oil in-place (OOIP).
- The resource is concentrated in 248 large reservoirs, holding 80 billion barrels of OOIP, primarily located in California, Alaska, and Wyoming (Figure 2).
- Numerous other states, such as Arkansas, Louisiana, Mississippi and Texas, contain significant volumes.
- Some undeveloped heavy oil resources underlie public lands, including much of the heavy oil deposits in Alaska. Much of the potential exists in already producing basins.

Figure 2 - Distribution of U.S. Heavy Oil Resources



Heavy Oil Technology

- Most heavy oil recovery is by thermal methods, including steam injection and, to a lesser extent, in-situ combustion, and cyclic steam injection. Schematic diagrams of cyclic steam injection and steam flooding are shown in Figures 3 and 4.
- Thermal technologies have been applied to produce heavy oil resource in shallow (less than 3,000 feet) reservoirs, particularly in California.
- These technologies have generally been applied to large fields that can achieve higher return on investment due to lower costs per barrel of incremental oil recovered.
- Efficient thermal EOR technology could enable nearly two-thirds of the resource in-place to be recoverable from favorable shallow heavy oil fields.
- Additional production of up to 500,000 Bbl/d is possible with further development of the resource.
- Proven technology is applicable to nearly half of the remaining resource (shallower than 3000 feet).
- New technology is required to address resources deeper than 3000 feet and the more shallow but environmentally-sensitive Arctic resources.
- Current production's limited to the "best" reservoirs.

Figure 3 – Cyclic Steam Injection

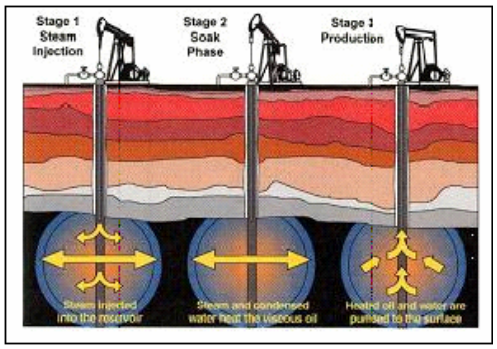
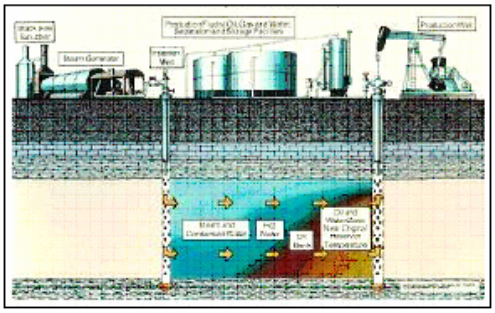


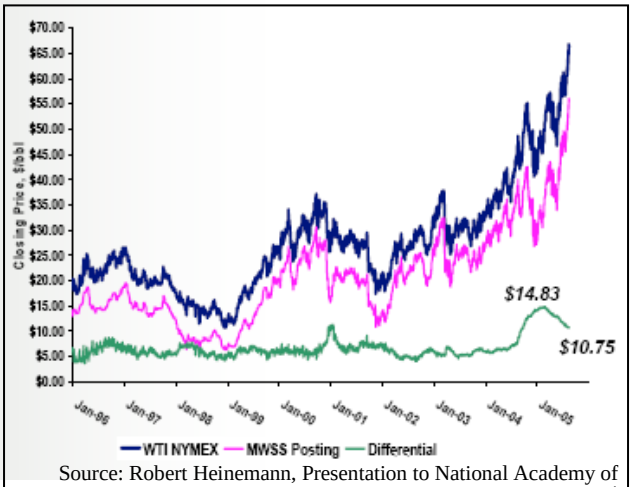
Figure 4 – Steam Flooding



Heavy Oil Economics

- Application of thermal recovery processes in heavy oil reservoirs in other basins depends largely on capital cost per barrel of steam generation.
- New cold production methods have less capital cost, but also have lower recovery efficiency.
- Oil price volatility is a significant deterrent to heavy oil project investment by industry, particularly smaller independent producers.
- Price differentials between heavy and light crude, due to crude quality, are substantial. (Figure 5)
- Expanded development is resource constrained – capital, people, investment, and "know how".

Figure 5 - Price Differential Between Light Sweet and Heavy Oils[2]



Source: Robert Heinemann, Presentation to National Academy of Sciences, 2005.[1]

Heavy Oil Environmental Factors

Environmental concerns associated with the development of heavy oil resources differ from those of other unconventional oil resources.

- Heavy oil production is controlled by current environmental laws and regulations that apply to conventional oil production. However, areas that have not experienced much oil development could face regulatory compliance and permitting challenges comparable to other unconventional sources of liquid fuels.
- Production techniques are established, but new approaches are needed to allow production of shallow Alaska North Slope (ANS) resources while protecting the permafrost.
- Air emissions challenges are associated with generation of steam for injection. Most projects use gas-fired generation to minimize emissions.
- Heavy oil projects require water for steam-generation; however, much of the water will come from the oil formation itself, as it is produced with the oil.

References

[1] Oil and Gas Journal, Vol 104.17 June 17, 2006; California Department of Oil Gas and Geothermal Resources, 2006.
[2] Robert Heinemann, Presentation to National Academy of Sciences, 2005