Naval Petroleum and Oil Shale Reserves

PROGRAM ON STRATEGIC UNCONVENTIONAL FUELS

PROGRAM OVERVIEW

Oil Shale • Tar Sands • Coal Derived Liquids
• Heavy Oil • CO₂ Enhanced Recovery

Tony Dammer
Colorado School of Mines
Oil Shale Symposium
October 17, 2007
Presenters and Topics

- Tony Dammer: Introduction
- Peter Crawford: Technology
- Hitesh Mohan: Economics
- Tom Wood: Environmental
- Jim Bunger: Energy Efficiency
Briefing Objectives

• Conventional Oil Supply Issues
• The U.S. Oil Shale Opportunity
• Energy Policy Act of 2005 – Section 369
• Conclusion
Is There a Fuels Issue?

- Peaking of Conventional Oil
- Demand Growth in China, India & Developing Nations
- Dependence on Middle East Supply
- Ethanol and Bio-fuels as a Solution
- National Economic Security
- Impact of Conservation and Renewables
- Decline in Discoveries
- Veracity of World Proved Oil Reserves
- Declining Saudi Spare Capacity
- 75% of Reserves owned by NOCs
- Oil Industry Consolidations

Is There a Fuels Issue?
Vulnerability

**Current SPR**
Protection from Short-Term Supply Embargos

**New SPR**
Absolute Long-Term Supply Assurance

*Growing concern that there is an imminent global fuel supply problem*

- Declining World Oil Supply
- National Security (Supply interdictions)
- Supply Veracity/Confidence
- Economic and Market Implications
National Energy Security

Strategic Petroleum Reserve
Insurance against short-term oil shortages caused by economic disruption and oil supply interdiction

Term Insurance
2007
Population: 306 Million
Domestic Production: 5 mmbbl/d
Domestic Consumption: 20 mmbbl/d

Strategic Unconventional Fuels
Long range energy planning for production of domestically derived replacement fuels

Whole Life Insurance
2030
Population: 360 Million
Domestic Production: 5 mmbbl/d
Domestic Consumption: 28 mmbbl/d
America’s Petroleum-Based Economy

- Consumes 20.8 million barrels per day (EIA, 2007)
- Dominated by transportation sector
- Will continue in the future
- National security and defense readiness concerns
- Alternative liquid fuels are needed

Total U.S. energy consumption: 108 Quadrillion BTU (EIA, 2004)
Defense Readiness Concerns

- Dependence on foreign oil
- Dependence on foreign refined fuels
- Higher fuel costs

Total Military Purchases in 2006: 312 Mbbls/D (DOD, 2007)

Jet Fuels 70%
Marine Fuel 15%
Ground Fuel 11%
Heating Oil 4%


The Opportunity: America’s Endowment of Solid and Liquid Fuels Resources

U.S. Solid and Liquid Fuels Resources
(Total endowment 9,033 billion bbls oil equivalent*)

- Coal Resources - 5,986 (EIA)
- Petroleum Reserves - 22 (EIA)
- Petroleum Already Consumed - 197 (EIA)
- Remaining Original Oil in Place - 307 (DOE/NETL)
- \(-\text{CO}_2\) EOR Target - 89 (DOE/FE)
- Heavy Oil - 100 (NETL)
- Tar Sand - 54 (DOE)
- Oil Shale Resources - 2,118 (USGS)
- Coal Already Consumed - 249 (www.cslforum.org/usa)

Units are in billion bbl-oil-equivalent coal - 10K BTU/lb; oil - 6M BTU/bbl

*not including energy losses in transformation to liquid fuel
U.S. Oil Shale Opportunity
The Big Prize!

• Huge and Secure - 1 Trillion Barrels Recoverable
  – Largest Domestic Source of Transportation Fuels
  – Largest Deposits in Colorado, Utah and Wyoming

• Concentrated - Up to 2 Million Barrels/Acre
  – No Other Resource is This Concentrated

• Potentially Economic
  – Results of Current Research Show Promise
  – Comparable to Alberta, Canada Oil Sands
  – Prior Failure of Industry in the U.S. Was Not the Fault of the Resource, Technology, or Environmental Issues
### Middle East Proved Reserves

<table>
<thead>
<tr>
<th>Country</th>
<th>Reserves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saudi Arabia</td>
<td>261.8 Billion Barrels</td>
</tr>
<tr>
<td>Iraq</td>
<td>112.5 Billion Barrels</td>
</tr>
<tr>
<td>UAE</td>
<td>97.8 Billion Barrels</td>
</tr>
<tr>
<td>Kuwait</td>
<td>96.5 Billion Barrels</td>
</tr>
<tr>
<td>Iran</td>
<td>89.7 Billion Barrels</td>
</tr>
<tr>
<td>Qatar</td>
<td>15.2 Billion Barrels</td>
</tr>
<tr>
<td>Oman</td>
<td>15.2 Billion Barrels</td>
</tr>
<tr>
<td>Yemen</td>
<td>4.0 Billion Barrels</td>
</tr>
<tr>
<td>Syria</td>
<td>2.5 Billion Barrels</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>685.5 Billion Barrels</strong></td>
</tr>
</tbody>
</table>

### U.S. Targeted Prize

<table>
<thead>
<tr>
<th>Type</th>
<th>Reserves</th>
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</thead>
<tbody>
<tr>
<td>Shale</td>
<td>900 Billion Barrels</td>
</tr>
<tr>
<td>F-T Coal</td>
<td>500 Billion Barrels</td>
</tr>
<tr>
<td>Tar Sands</td>
<td>11 Billion Barrels</td>
</tr>
<tr>
<td>Oil Reserves</td>
<td>23 Billion Barrels</td>
</tr>
<tr>
<td>Heavy Oil</td>
<td>50 Billion Barrels</td>
</tr>
<tr>
<td>EOR Oil</td>
<td>89 Billion Barrels</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1.6 Trillion Barrels</strong></td>
</tr>
</tbody>
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*Ethanol only
Legislative Response
Energy Policy Act of 2005
Section 369 (h)

Secretary of Energy shall, in cooperation with the Secretary of Interior and the Secretary of Defense, establish a Task Force to develop a program to coordinate and accelerate the commercial development of strategic unconventional fuels.
The Unconventional Fuels Task Force

- **Federal agencies**
  - Department of Energy
  - Department of Defense
  - Department of the Interior

- **Participating states**
  - Colorado
  - Kentucky
  - Mississippi
  - Utah
  - Wyoming
Major Task Force Finding

“The Nation is substantially at risk, from an economic and security perspective, to warrant development of an unconventional fuels program with attendant policies and government actions to promote and accelerate industry development.”
The Office of Petroleum Reserves shall:

- Coordinate Federal Government Actions That Facilitate The Development Of Strategic Fuels
- Evaluate the Strategic Importance Of Unconventional Sources Of Strategic Fuels To The Security Of The U.S.
- Identify, Assess, And Recommend Federal Actions Required To Assist In The Development And Manufacture Of Strategic Fuels
- Coordinate And Facilitate Appropriate Relationships Between Private Industry And The Federal Government To Promote Sufficient And Timely Private Investment
- Provide staff support to the Task Force
Strategic Unconventional Fuels
Program Goals

• Accelerate development of domestic unconventional fuels

• Promote effective environmental stewardship and impact mitigation

• Mitigate potential adverse socio-economic impacts on states and localities

• Generate substantial public benefits while ensuring government fiscal responsibility
Initial Task Force Recommendations

• Provide an Effective Land Tenure System.
• Provide an inclusive regulatory system and review process.
• Create a fiscal regime that attracts needed private capital.
• Craft a fast-track technology program to attract investment.
• Create an integrated local and regional infrastructure plan.
• Establish a program for development planning, funding, and training that mitigates adverse local impacts.
• Ensure the appropriate organizational structure at state, local, and Federal levels exist to promote and accelerate development.
The World According to Cap’n Crunch
A Mythic Journey to a Self-Fulfilling Prophecy of Defeat

• **Historic** - Repeated horrors of “another Black Sunday, another boom-bust cycle.” “The best way to screw up here is to move too fast.”

• **Technical** - “The failures of the past will inevitably repeat themselves as the cost of technology development will always outpace the price of oil.”

• **Resource** – “Oil Shale has one-third the energy density of Cap’n Crunch” and “the energy content of a baked potato.”

• **Land Use** - Oil shale development would “transform much of Northwestern Colorado into a full blown industrial zone that would make the likes of Gary, Indiana look positively alluring in comparison.”

• **Water** – An industry that uses “about 3 barrels of water per barrel of oil produced” raises questions of sustainability.

• **Economics** – “Shale oil – fuel of the future and always will be.” Initial production costs “will be at least $70 and $95 per barrel for a first of a kind operation to be profitable.”
Technology Introduction

- American Oil Production LLC
- Anadarko Petroleum Corp.
- Argyll Energy LLC
- Carbon Recovery Corp.
- Chattanooga Corp.
- Chevron USA Inc.
- Conoco Phillips
- EGL Resources
- Electro-Petroleum Inc.
- Exxon Mobil Corp.
- Brent Fryer
- Global Resource Corp.
- Great Western Energy LLC
- Imperial Petroleum Recovery Corp.
- Independent Energy Partners Inc.
- Kennecott Exploration Company
- J.W. Bunger and Associates, Inc.
- James A. Maguire, Inc.
- Millennium Synthetic Fuels, Inc.
- Mountain West Energy Inc.
- Natural Soda Inc.
- Nevtaah Capital Management Inc.
- Oil Shale Exploration Corp.
- Oil Tech Inc.
- Petro Probe Inc./Earth Search Sciences
- Phoenix Wyoming Inc.
- Purple Mountain Ventures
- Raytheon
- Reynolds Raw Materials
- Red Leaf
- Shell Frontier Oil & Gas
- Syntec Energy LLC
- Temple Mountain Energy Inc.
- Western Energy Partners LLC
- Great Western Energy Corp.
Reports

Development of America’s Strategic Unconventional Fuels Resources - Initial Report to the President and Congress of the United States

Secure Fuels from Domestic Resources – The Continuing Evolution of America’s Oil Shale and Tar Sands Industries

Integrated Strategy and Program Plan

Volume I
Preparation Strategy, Plan, and Recommendations

Volume II
Resource-Specific and Cross-cut Plans

Volume III
Resource and Technology Profiles

http://www.unconventionalfuels.org