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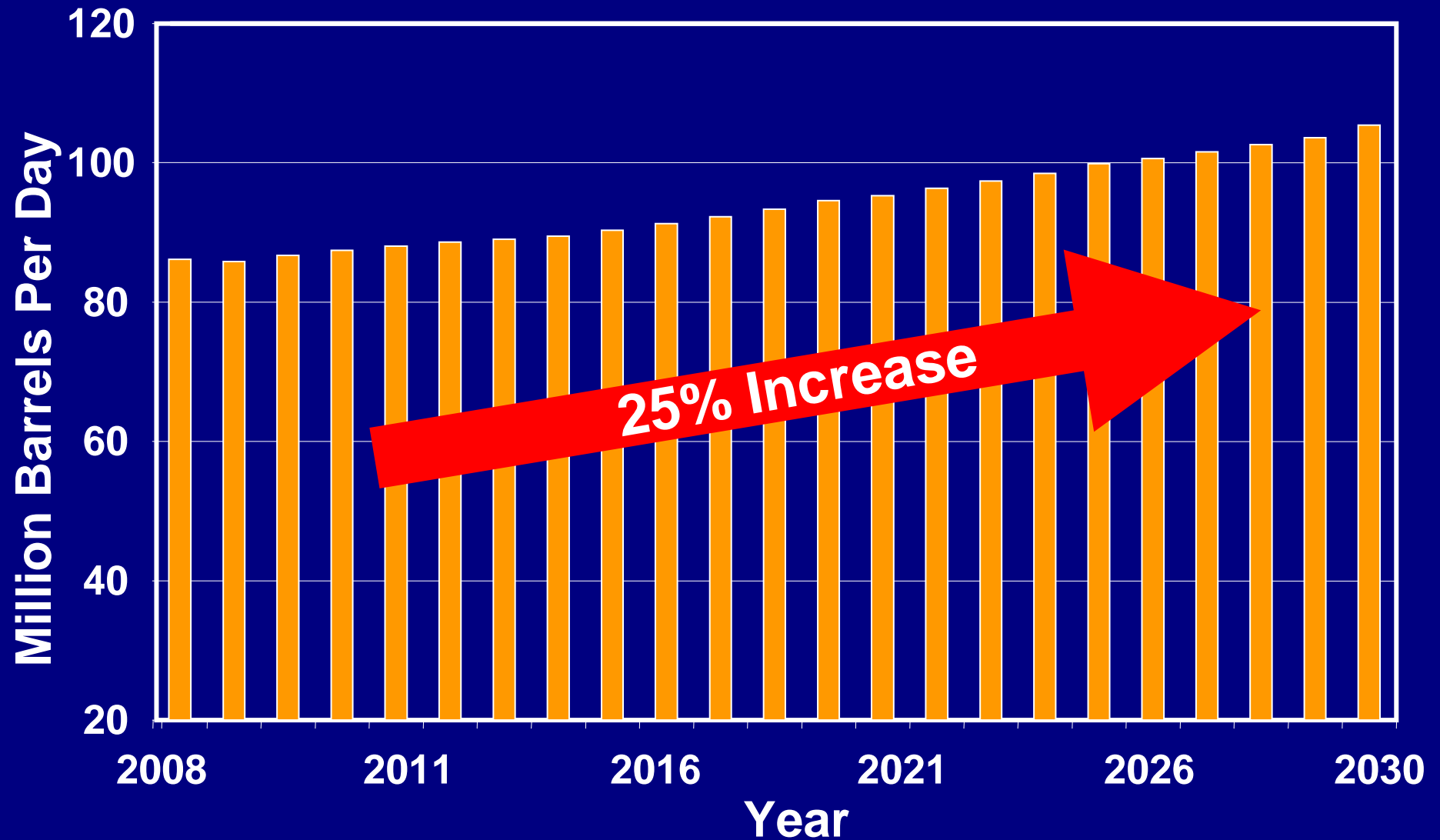
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Unlocking Ten Trillion Barrels of Global Oil Shale Resources - The State of the Industry

Khosrow Biglarbigi
INTEK, Incorporated

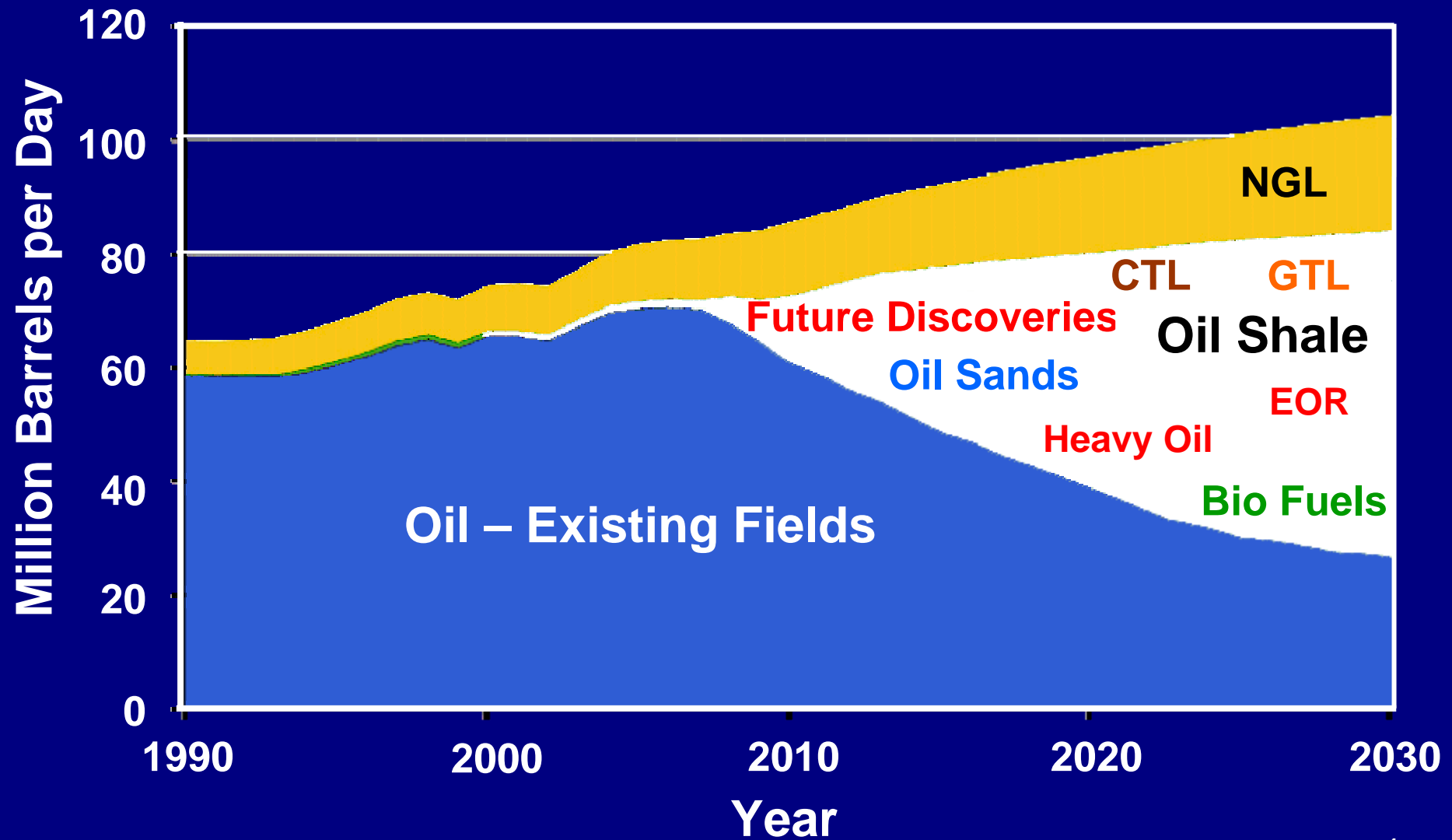


Demand For Liquid Hydrocarbon Worldwide



Source: EIA, 2009

Global Liquid Hydrocarbon Supply

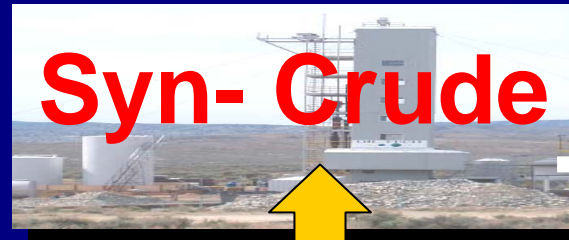


Source: IEA, 2008

What is Oil Shale?



Rock
Kerogen

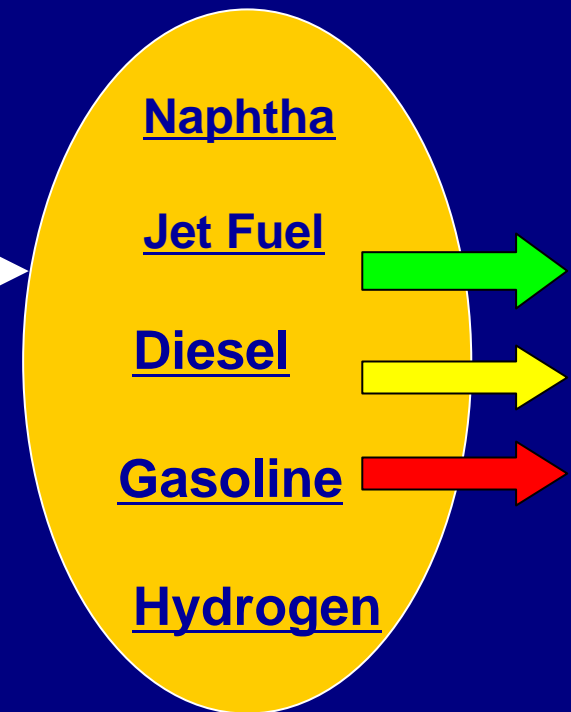


Syn- Crude



700 - 800 °F

Pyrolysis



Upgrade

10 Trillion Barrels of Shale Oil Worldwide



Countries With Oil Shale Deposits

Known Resources (Barrels)

The background of the slide features a silhouette of an oil rig against a warm, orange-hued sunset sky. The rig's structure, including its derrick and support beams, is clearly visible against the bright horizon.

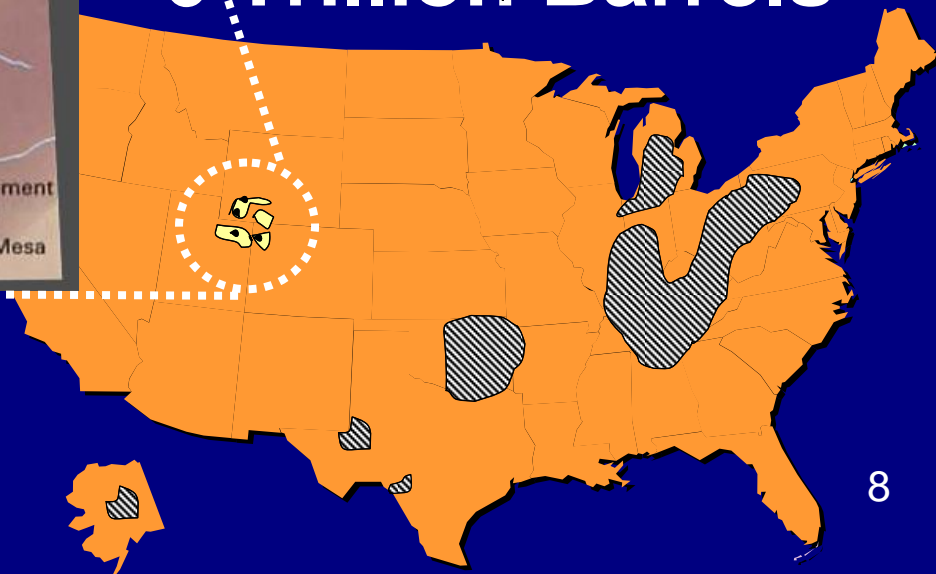
Asia	27 Billion
Australia	32 Billion
Africa	100 Billion
Europe	120 Billion
MENA	153 Billion
Eurasia	270 Billion
Americas	6,100 Billion

America's Oil Shale Most Concentrated Hydrocarbon Deposit

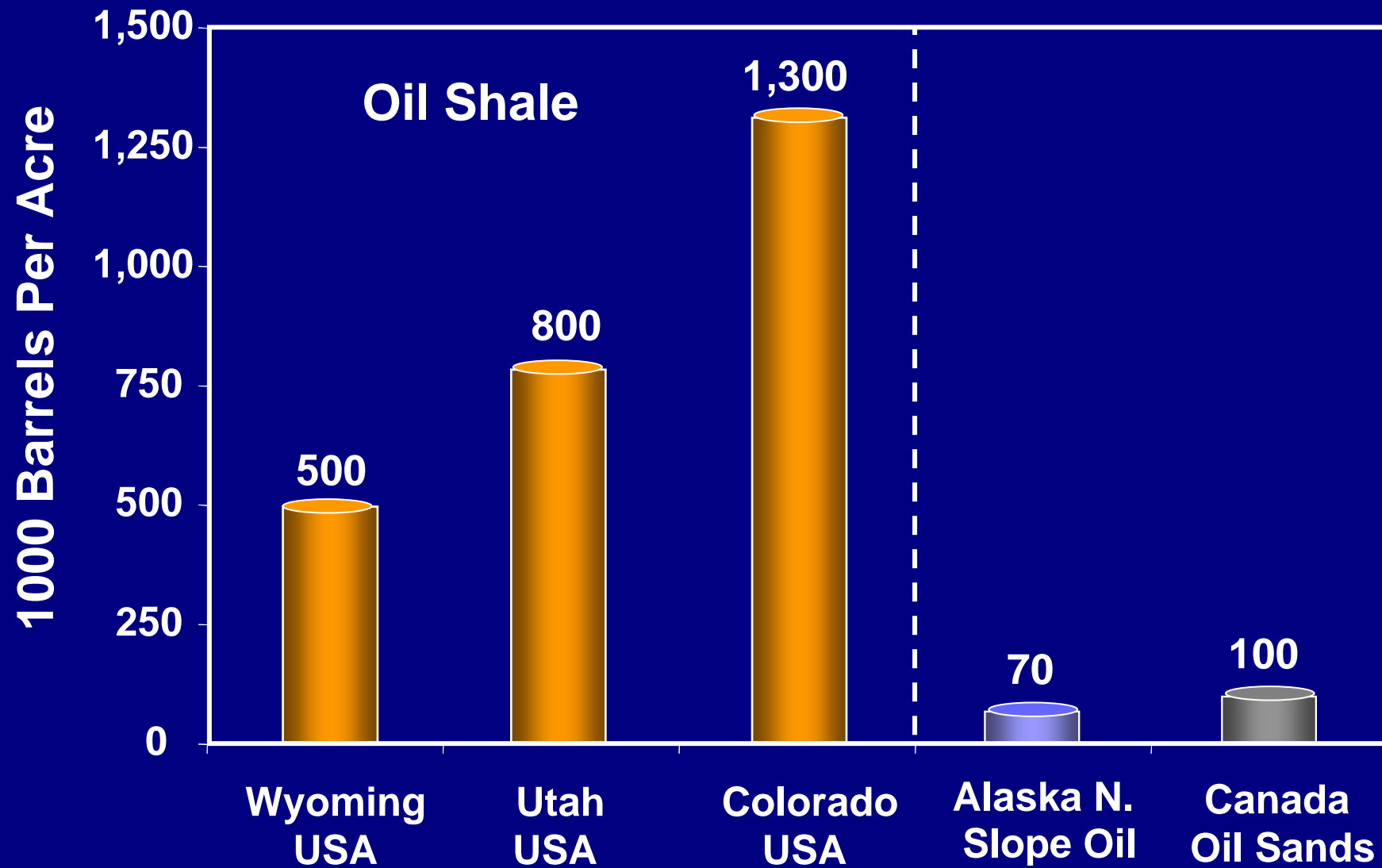
2 Trillion Barrels



6 Trillion Barrels



Substantial Areal Density



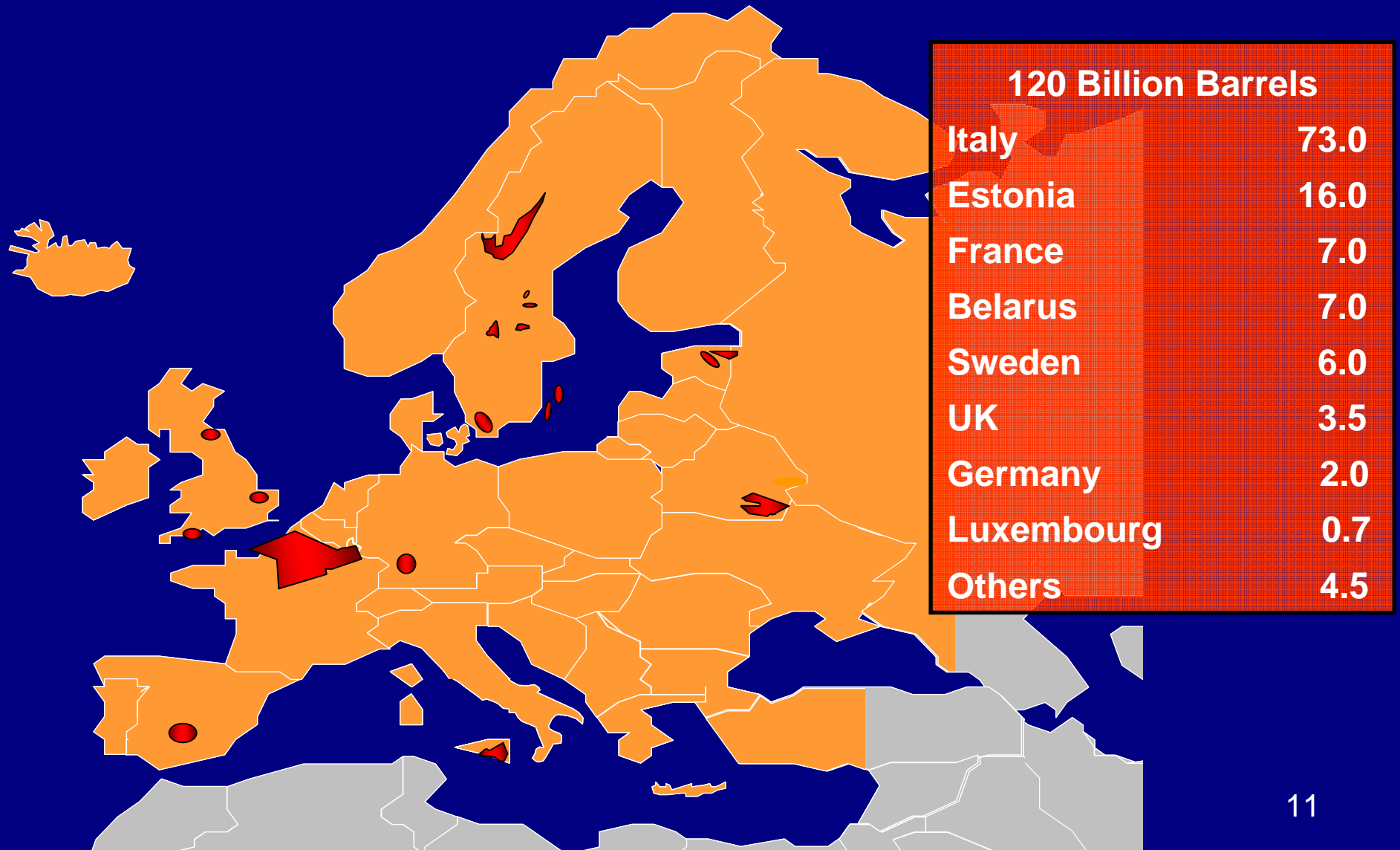
The Mahogany Zone



- The Most Prolific
- Up to 1000 Ft Thick
- Up to 75 Gal/Ton



Europe's Known Oil Shale Resources

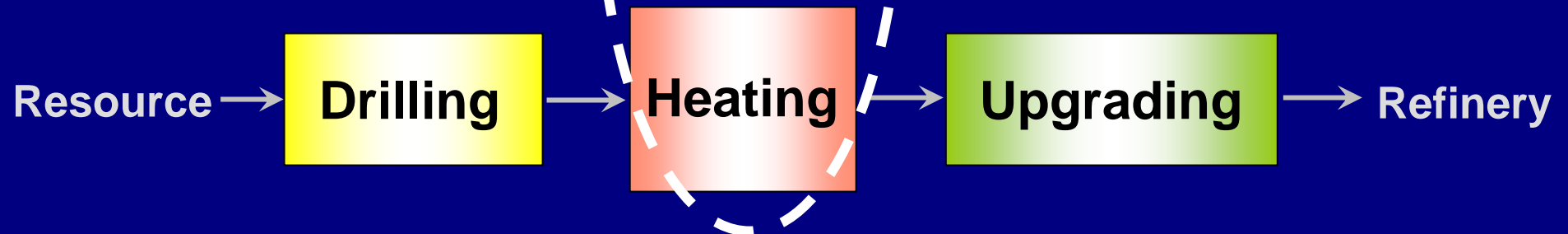


Oil Shale Production Processes

Surface Process

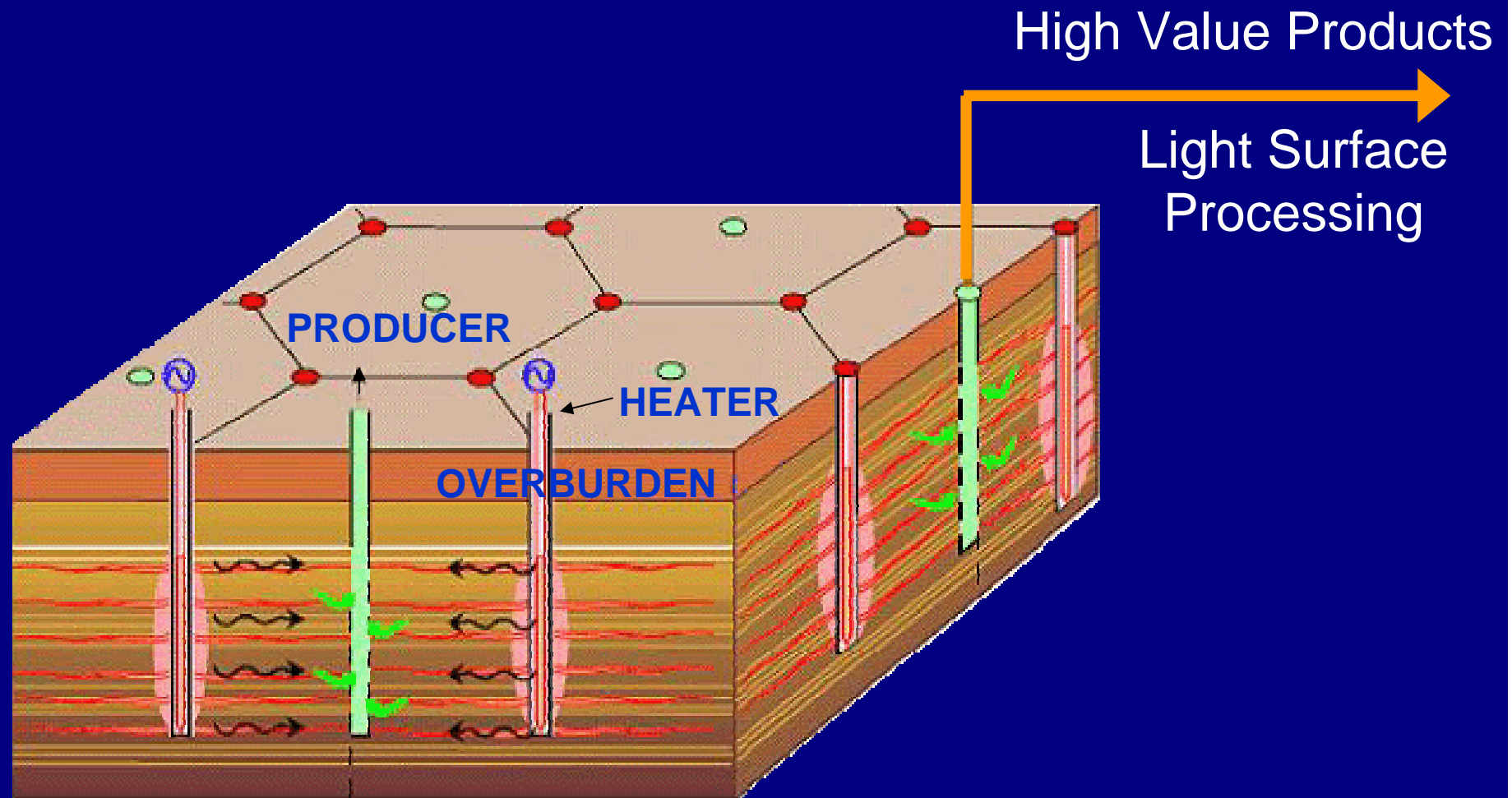


In-Situ Process



Choke Point

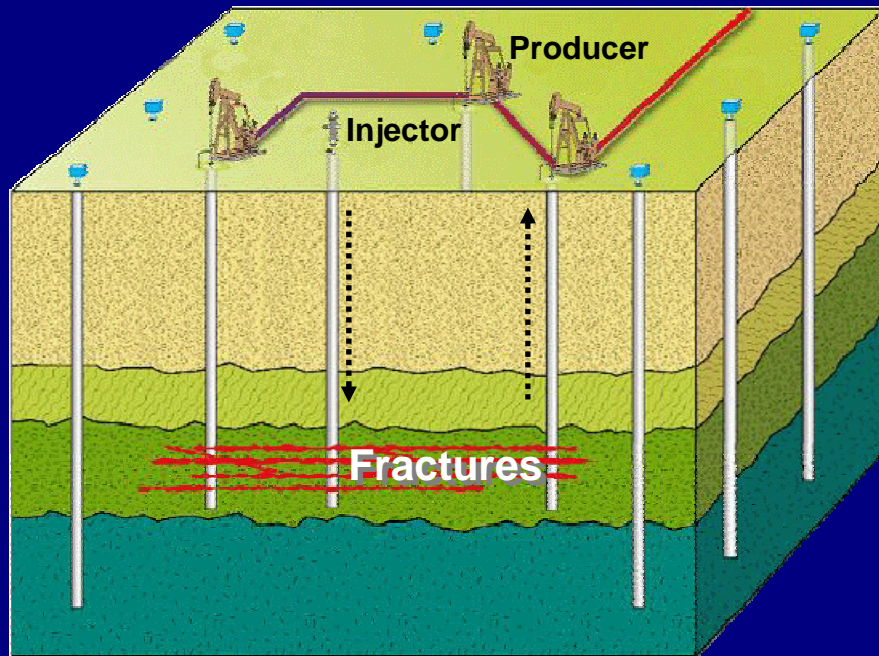
Shell In-Situ Conversion Process Pilot Test (Colorado, USA)



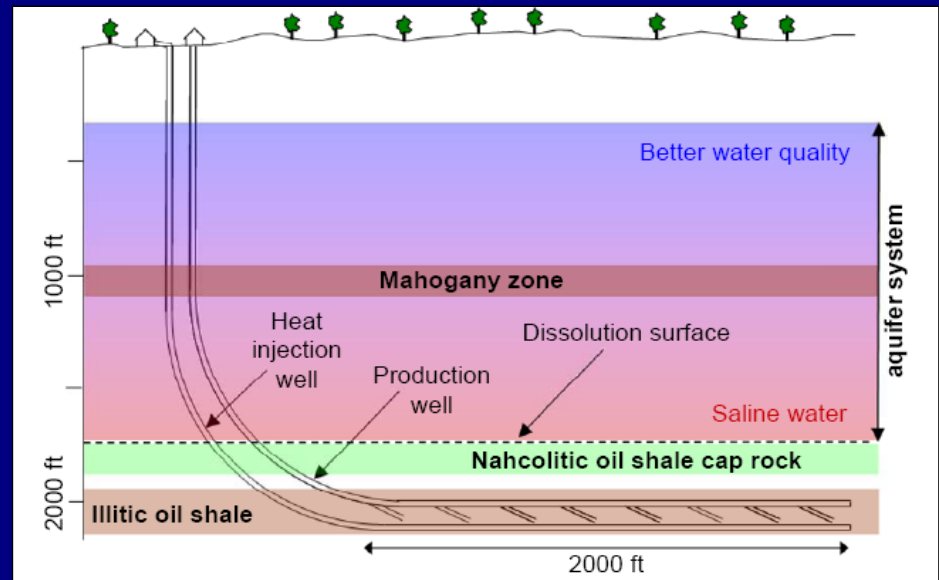
Other Examples of In-Situ Technology

Pilot Tests (Colorado, USA)

Chevron Process

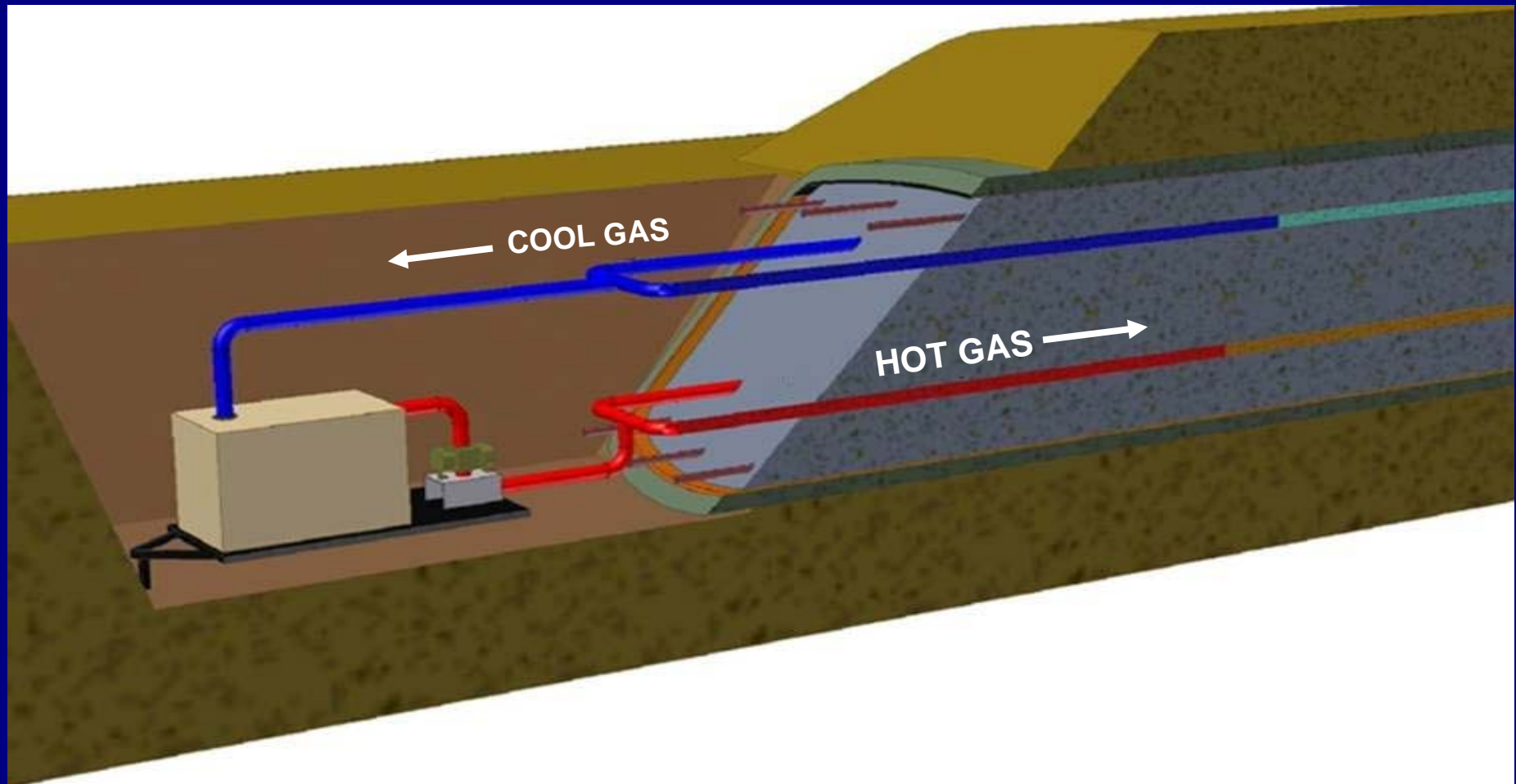


AMSO Process



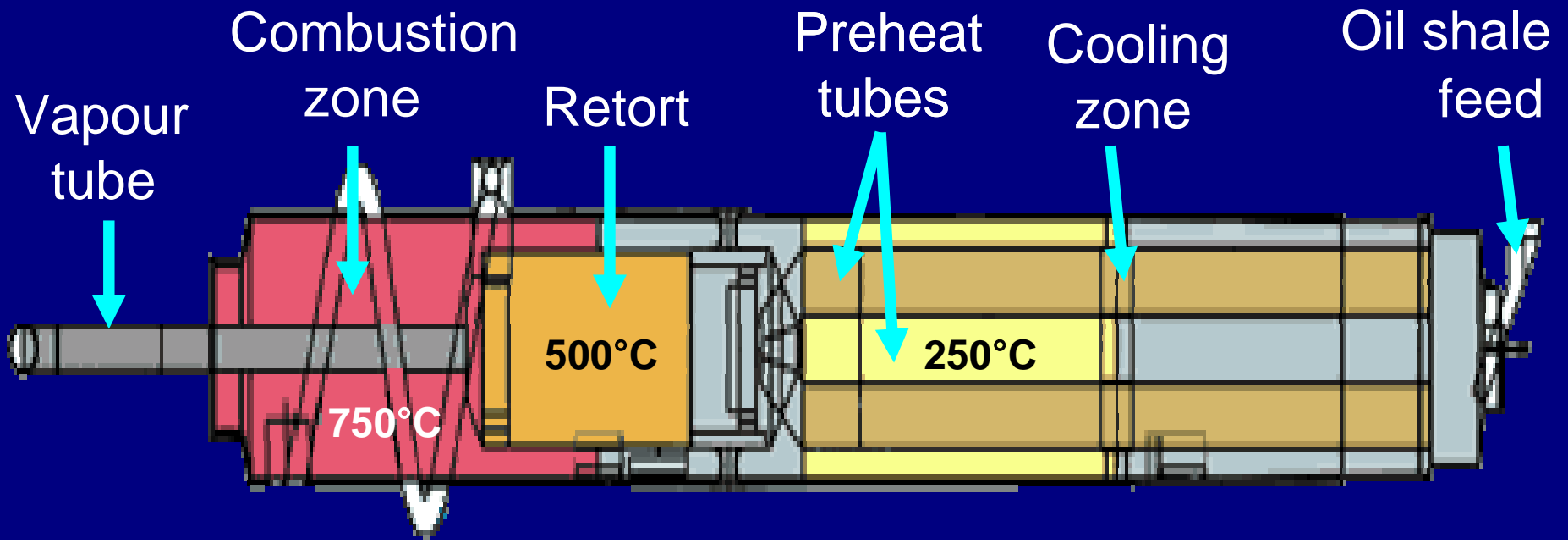
Ecoshale In-Capsule Technology

Pilot Test (Utah, USA)



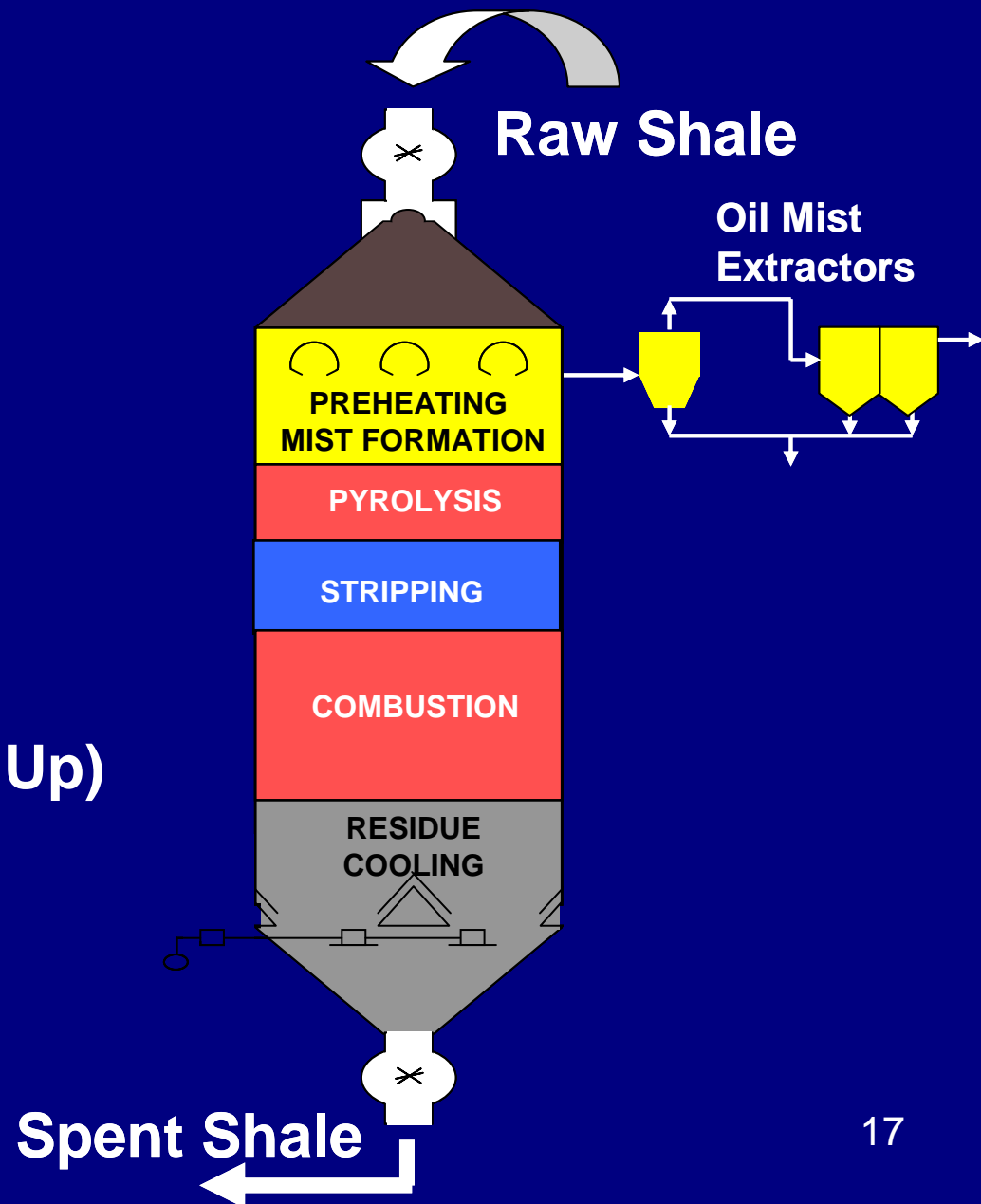
Alberta Taciuk Processor (ATP)

Pilot Test (Utah, USA)

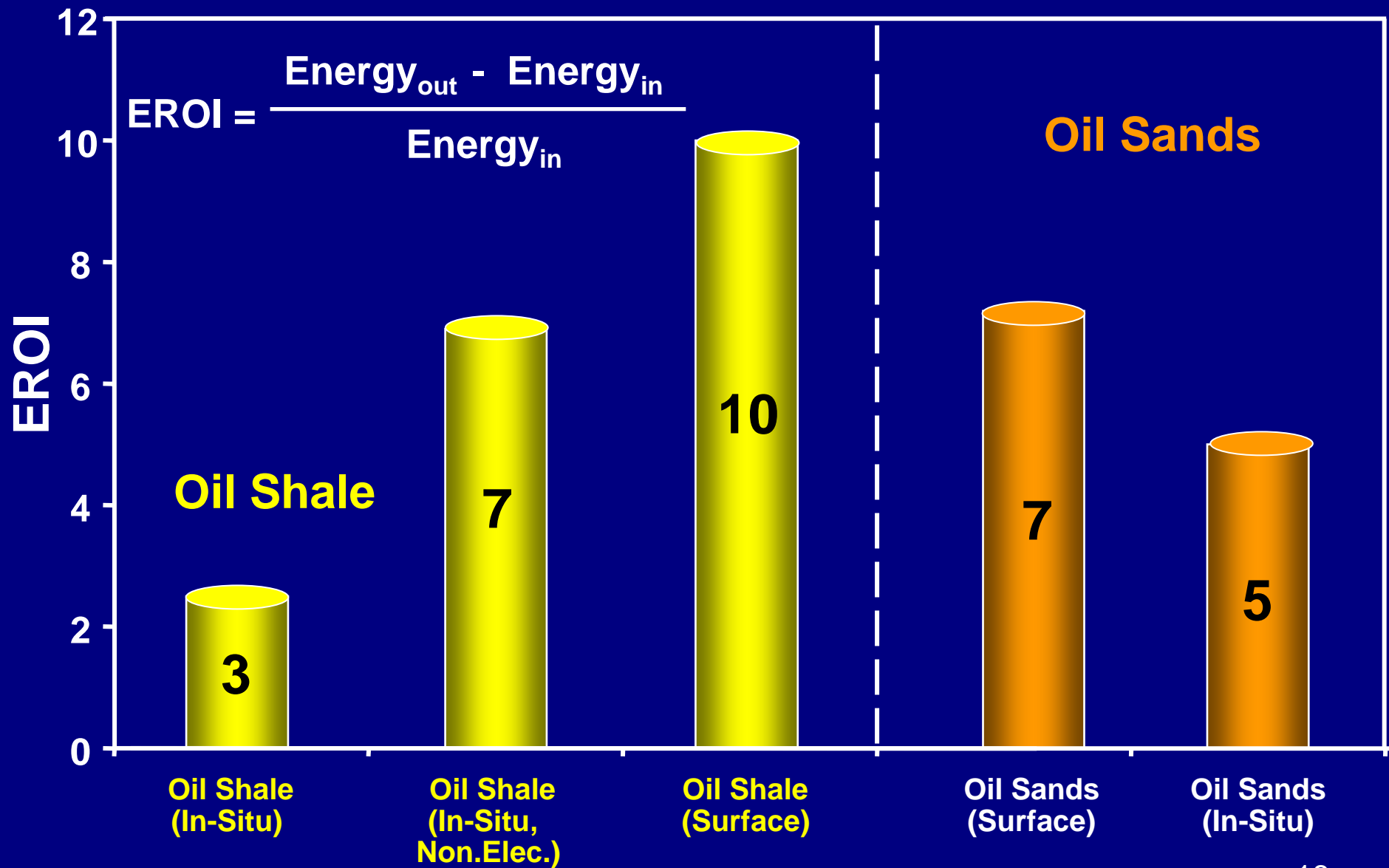


Gas Combustion Retort (GCR)

- Brazil (4,000 Bbl/d)
- China (4,000 Bbl/d)
- Estonia (6,000 Bbl/d)
- Australia (Project Scale Up)



Energy Return on Investment (EROI)



Source: US DOE, 2007



OIL SHALE
SYMPOSIUM
Tallinn 2009



“Oil shale is a local asset under global constraints.”

Klaus Brendow, Senior Advisor
World Energy Council

June 9, 2009

Oil Shale Project Costs

Item	Unit	Range
Capital Cost	\$/BPD*	45K-65K
O&M Cost	\$/Bbl	15-25

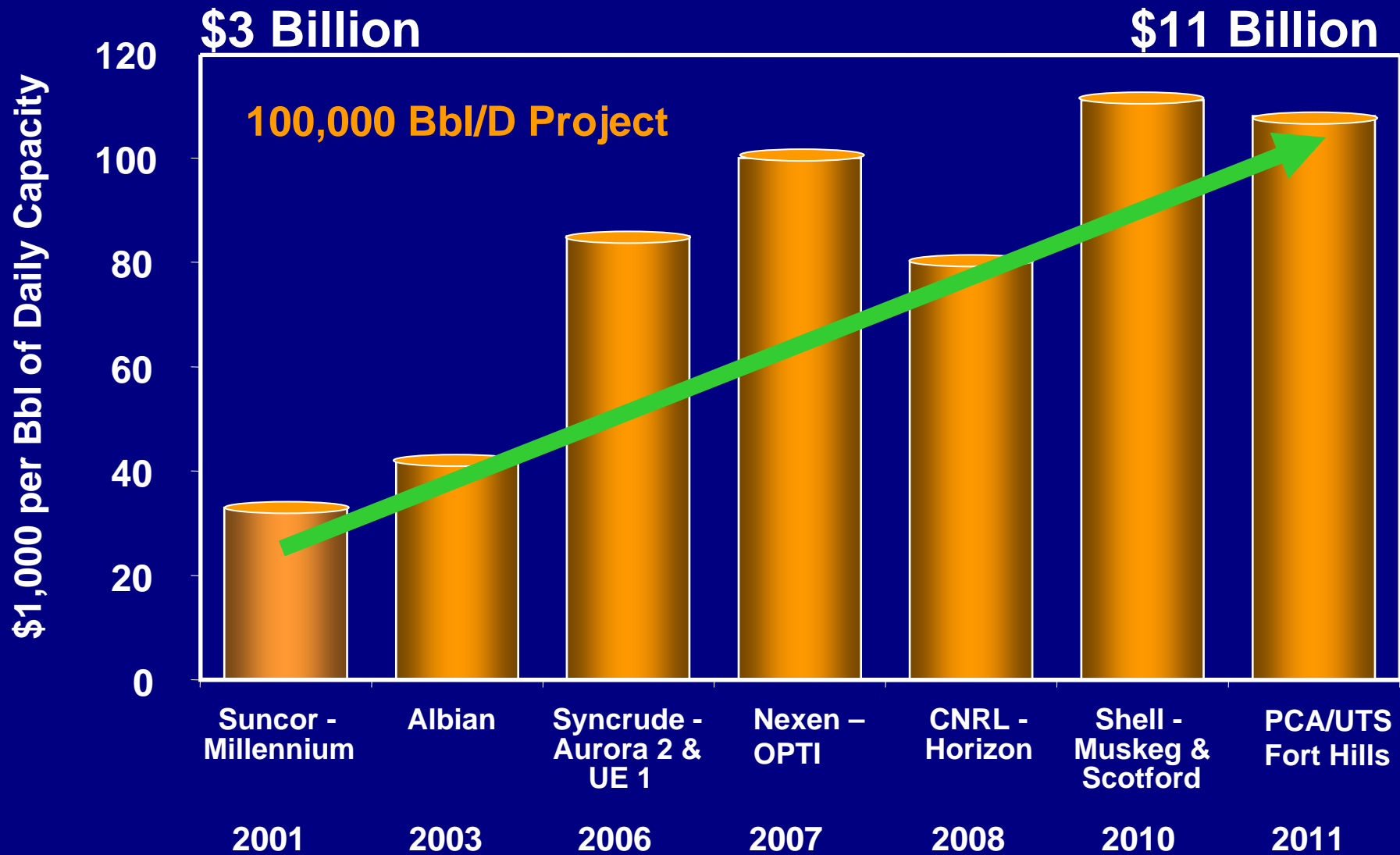
* Barrel of Daily Capacity

Canadian Oil Sands Operating Costs



Source: Suncor, 2008

Canadian Oil Sands Capital Costs





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Shell CEO Says Higher Costs Limit Canadian Oil Sands Projects

Oct 8, 2009

Oct. 8 (Bloomberg) -- Higher costs and low oil prices are limiting further development of oil sands projects in Canada, the chief executive officer of Royal Dutch Shell Plc said.

"Costs have risen very clearly in the Alberta region for new projects, hence new projects are not entirely profitable at today's oil prices," **Peter Voser** told reporters today after giving a speech in Washington. "Costs have to adjust to lower oil prices. Once they come down, then further projects can be considered."

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Total Canada Chief Says Oilsands Need Pricier Oil

Oct 4, 2009

The new chief executive of Total SA's Canadian unit said on Monday the French oil major will delay giving the final go-ahead for its Joslyn oil sands project in Alberta, waiting until higher oil prices allow it to wrest a solid return from its Canadian investments.

Photograph by: AFP-Getty Images, Herald Archive

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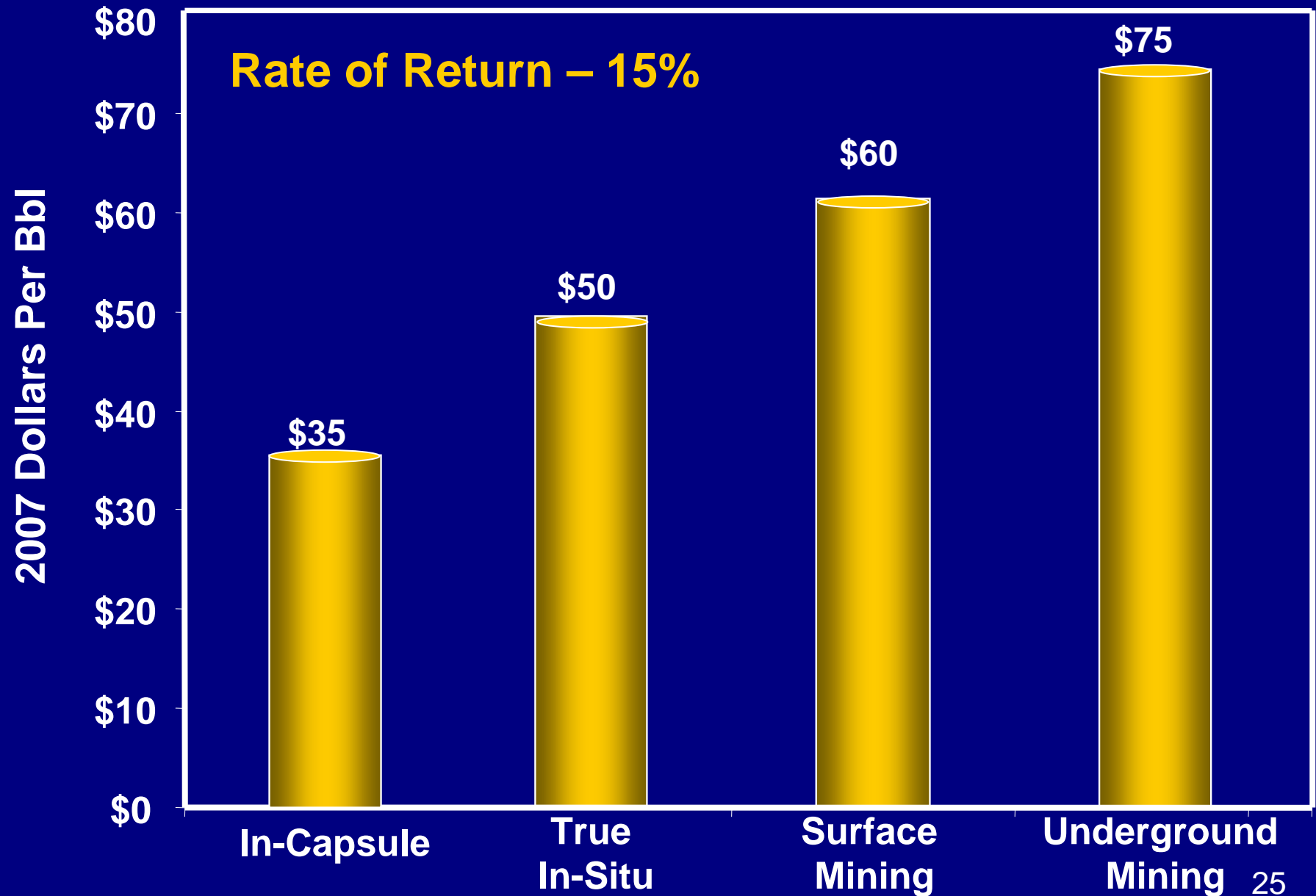
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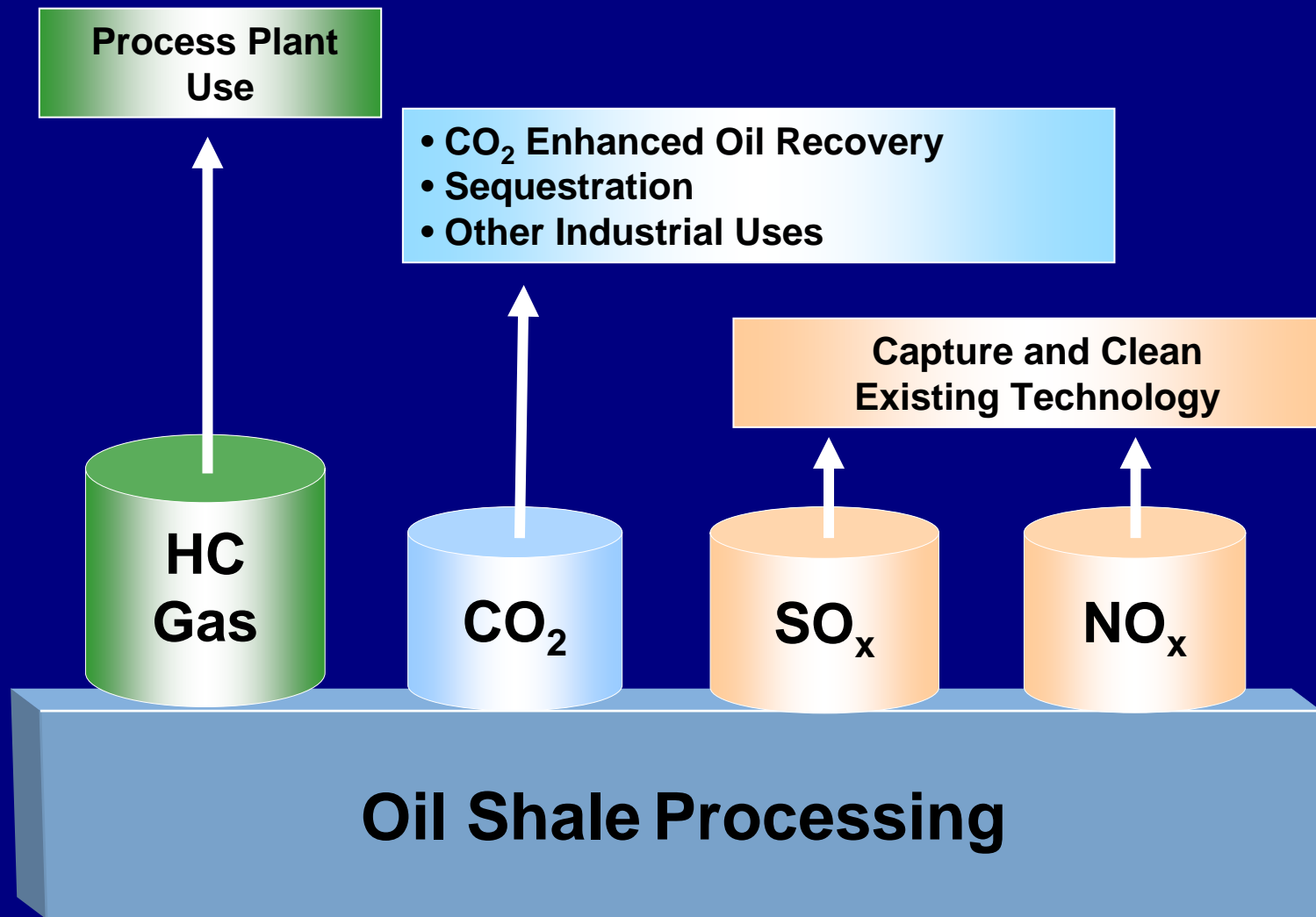
Economic Price for Oil Shale Technology



Source: INTEK, Inc., 2008

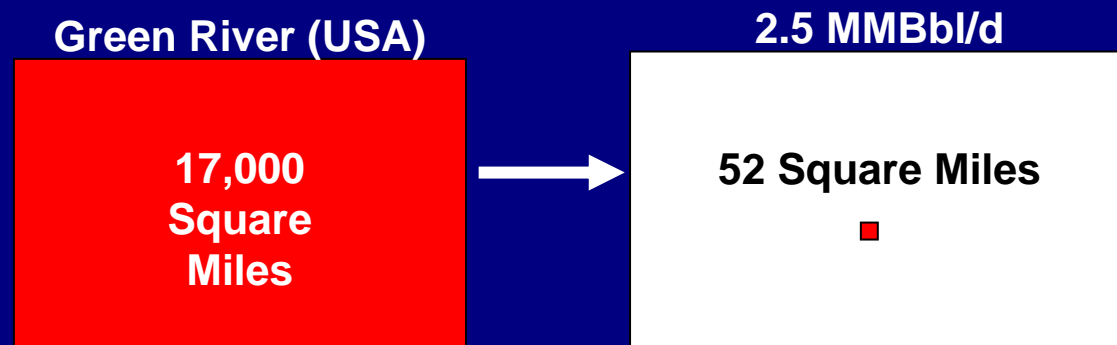
Oil Shale Environmental Impacts

Air Quality



Land Use Depends On The Process

- 1 MMBbl/D Production for 40 Years
 - **Surface: 30 Square Miles**
 - **In-Situ: 15 Square Miles**
- Example for 2.5 MMBbl/D Industry:
 - **52 Square Miles**

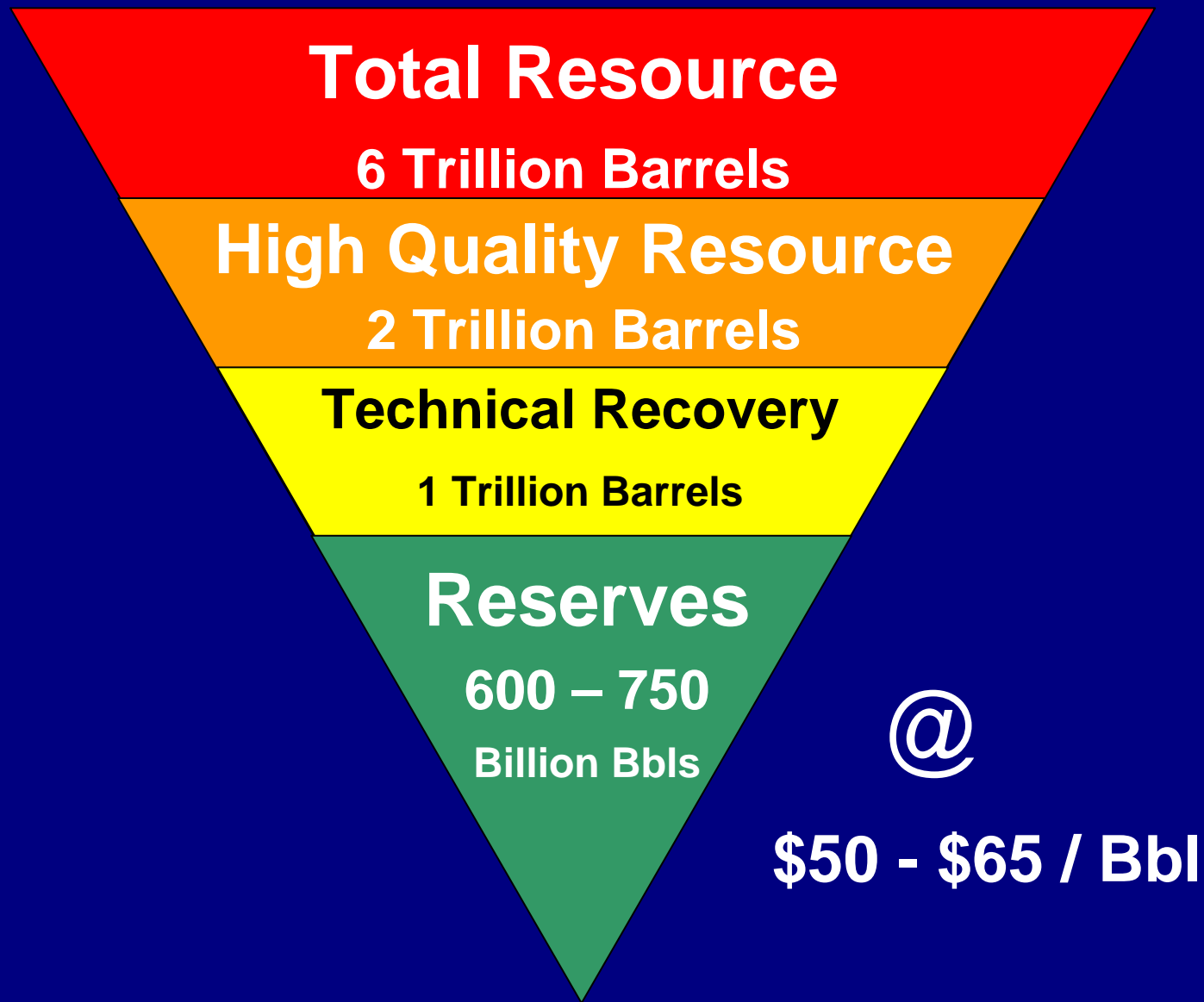


Water Requirements

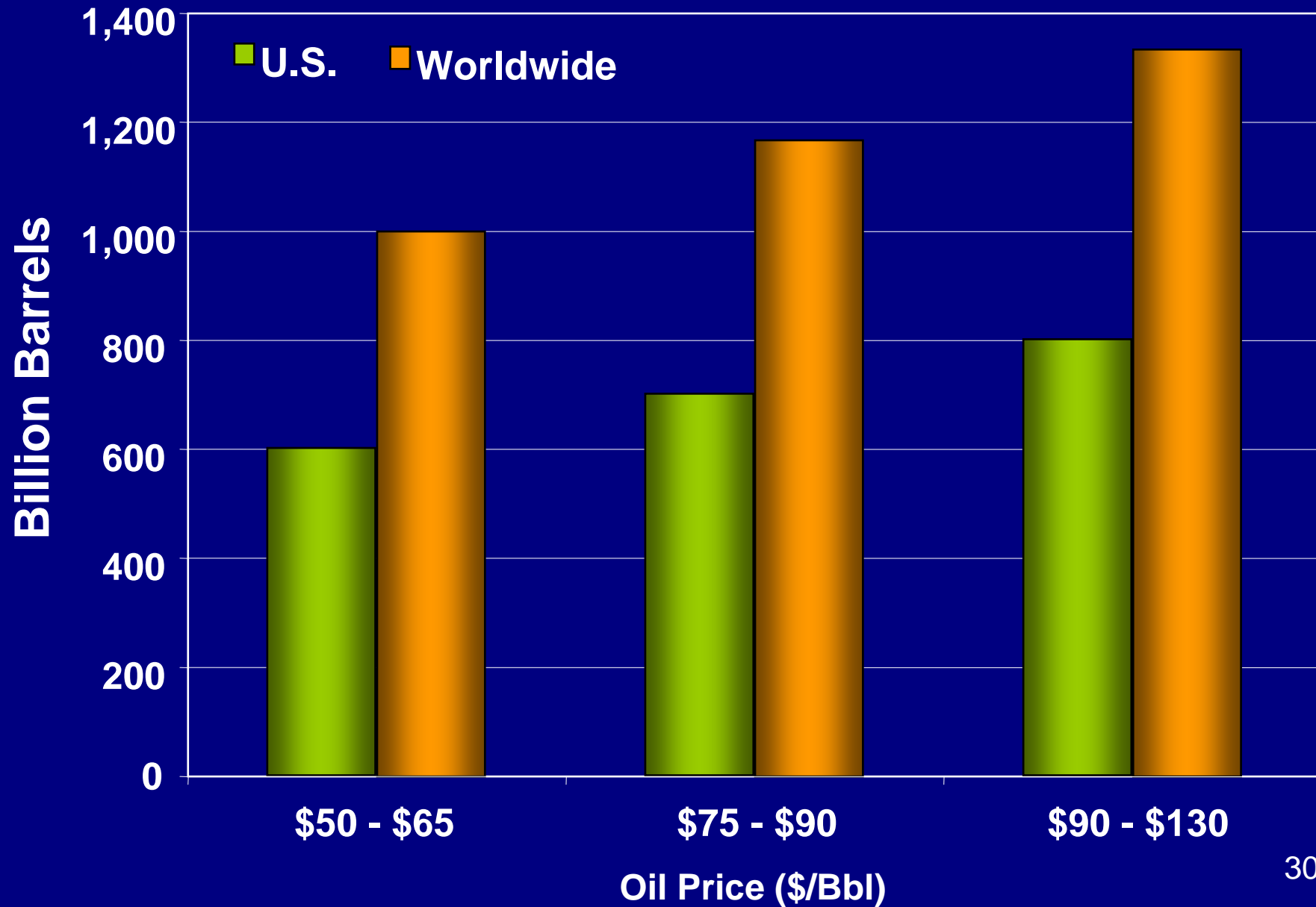
- **1-3 Barrels of Water per Barrel of Shale Oil**
- **Challenges:**
 - Water rights
 - Water availability
 - Water runoff
 - Ground water protection



The Prize (USA Example)



Reserves Potential Worldwide



Summary

- Over 10 trillion barrels of in place resource
- Conversion technologies are advancing rapidly
- Estimated reserves of up to 1.3 trillion barrels worldwide
- Oil Price is a key driver for its development
- Requires concerted effort by the private sector, governments, and local communities

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Enter your section in the DL Evaluation Contest by
completing the evaluation form for this presentation or
go online at:

http://www.spe.org/events/dl/dl_evaluation_contest.php



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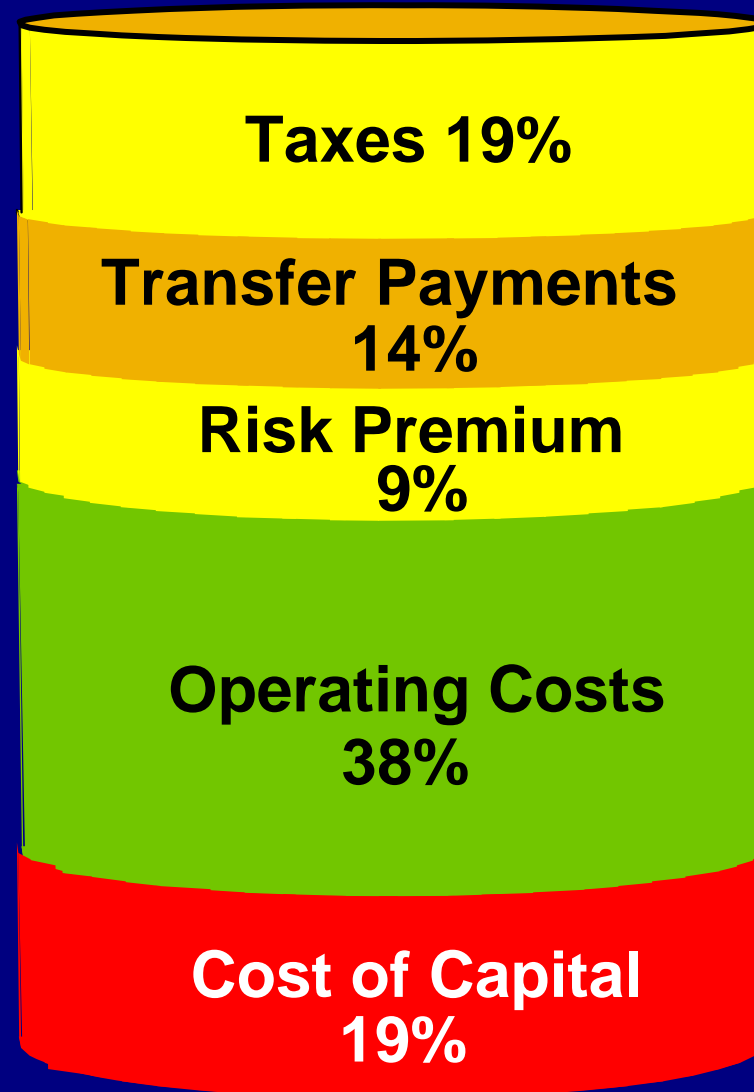
Appendix

Activities in Estonia

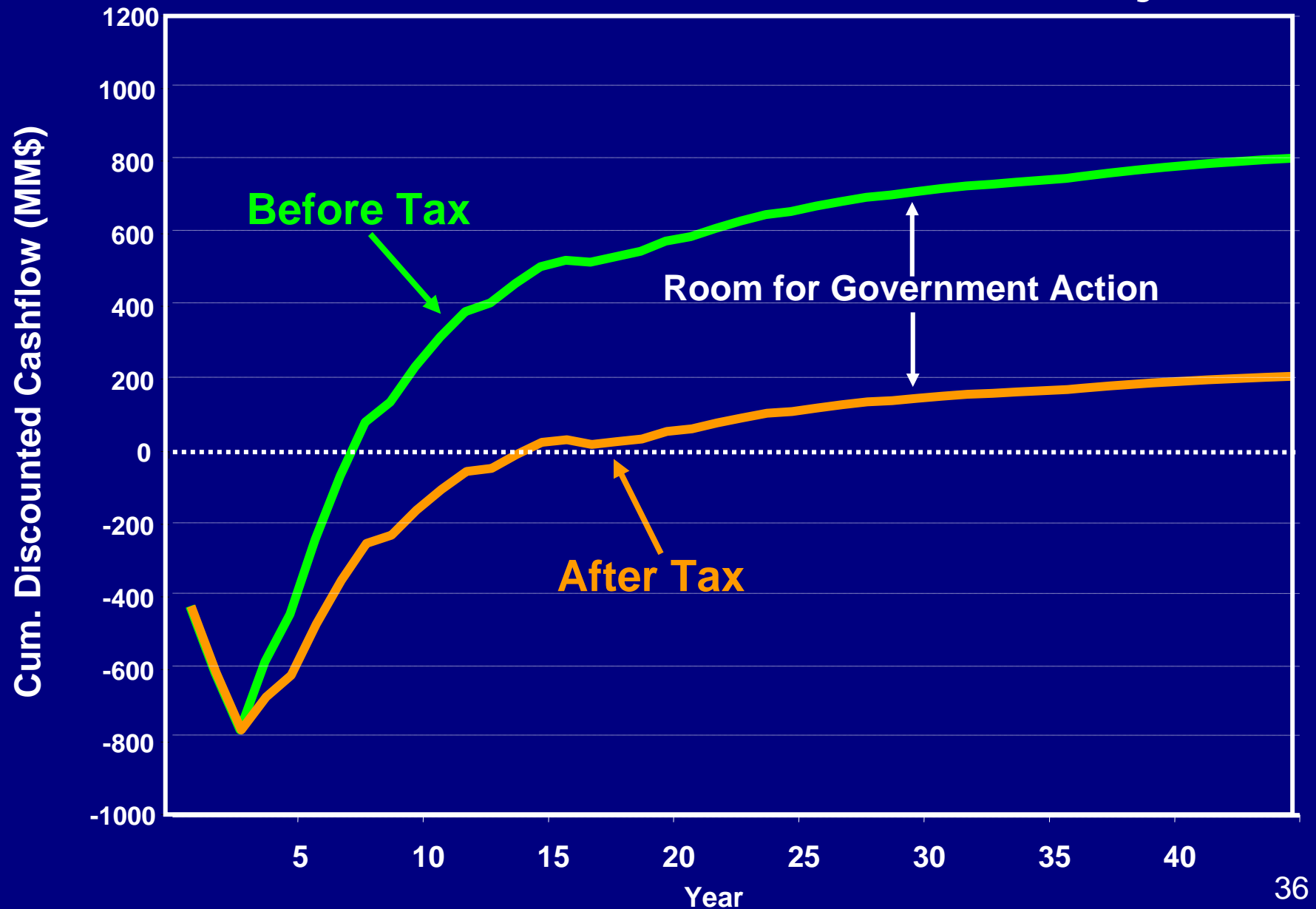


Breakdown of Economic Price for Generic Surface Project

\$60/Bbl



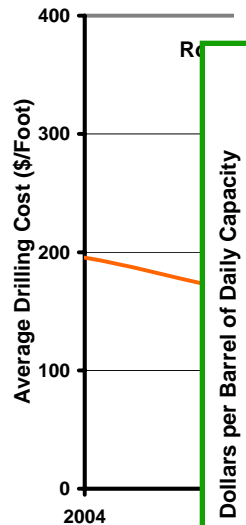
Cashflow of a Generic Oil Shale Project



Source: INTEK, Inc., 2008

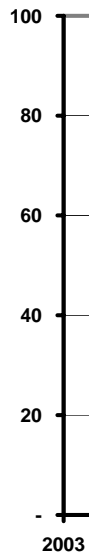
Oil Shale Costs are Impacted A Few Examples

Drilling Costs



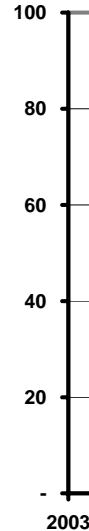
Mining Costs

1,000 Dollars per Barrel of Daily Capacity



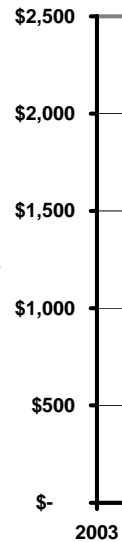
Upgrading Costs

1,000 Dollars per Barrel of Daily Capacity



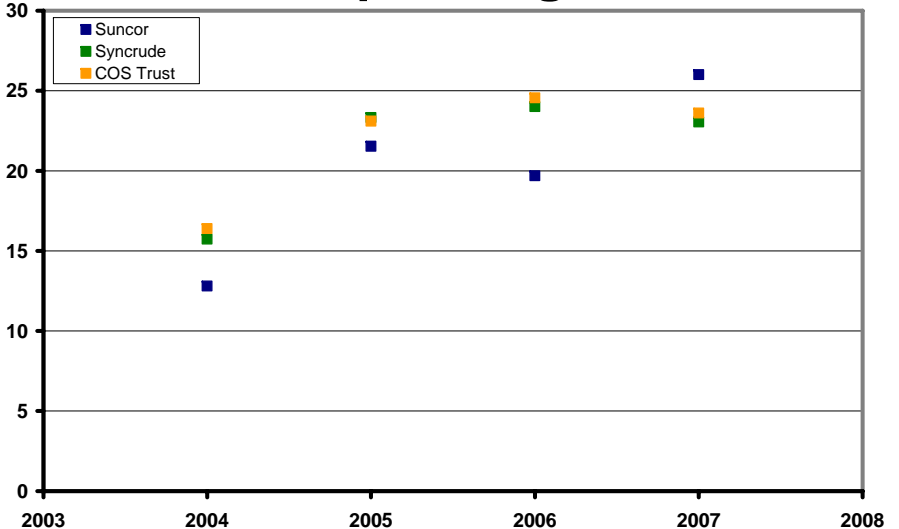
Tubular Steel Price

Price per Ton



Operating Costs

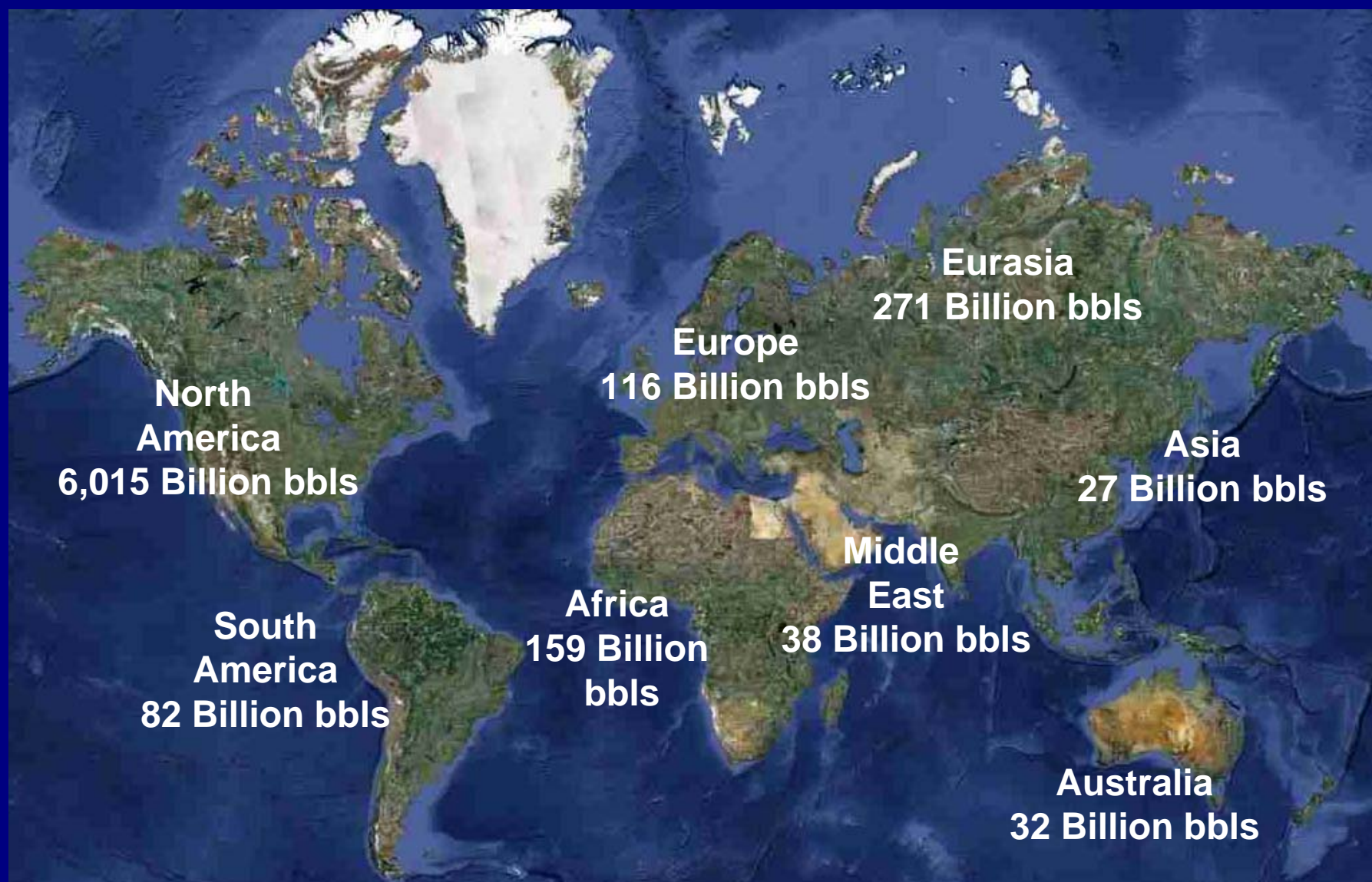
Operating Costs (\$/Bbl Produced)



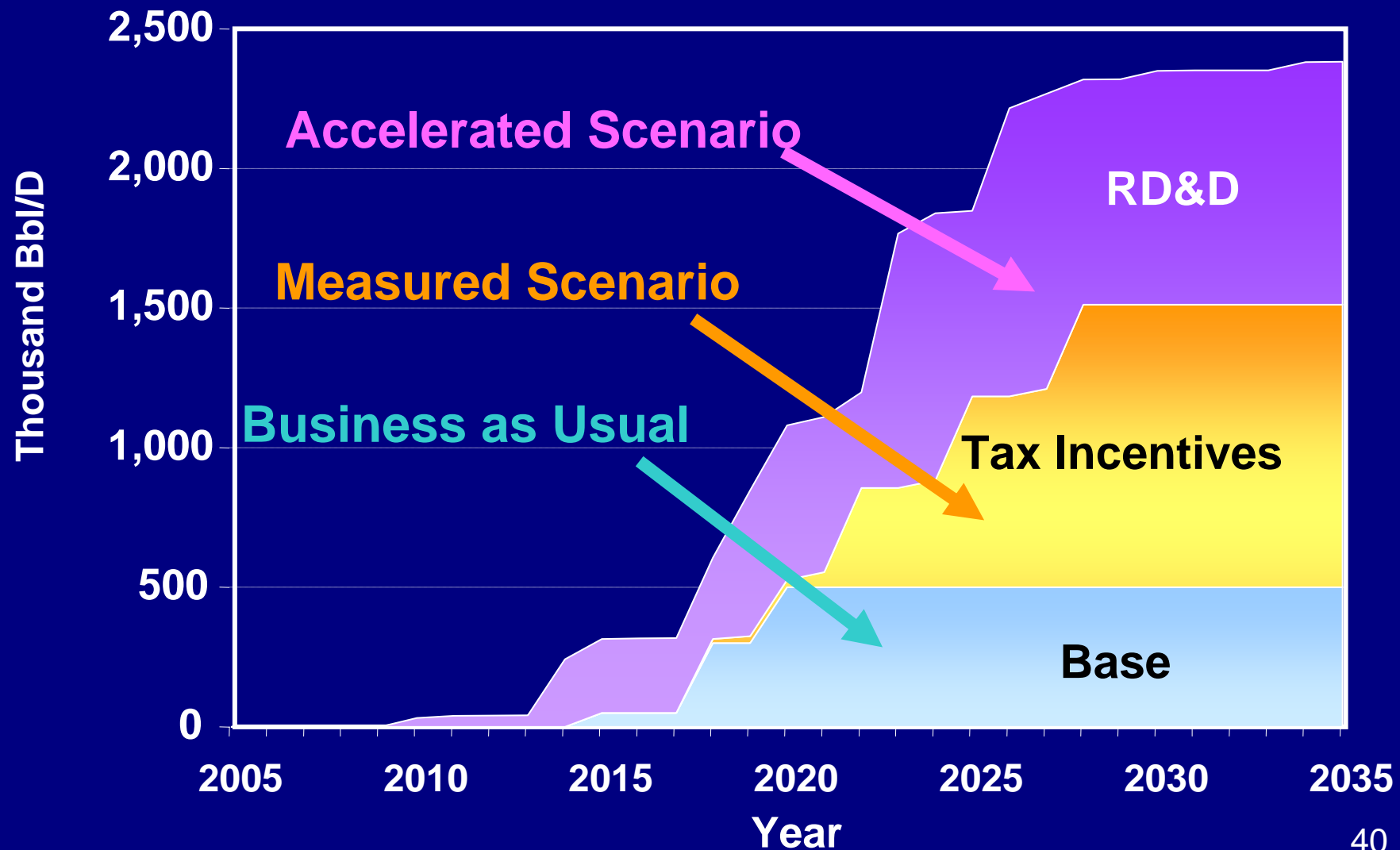
Worldwide Oil Shale Activities



10 Trillion Barrels of Shale Oil Worldwide



Projected Production Potential (Shale Oil in the U.S.)



Source: US DOE, 2007

Development Hurdles

- **Access to Land**
 - 70% on Federal Land
 - No Commercial Leasing Program
- **RD & D**
- **Environmental Permitting**
- **Fiscal Regime**