Strategic Significance of America's Oil Shale Resource

2005 EIA Midterm Energy Outlook Conference

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US Department of Energy, Washington D.C.
April 12, 2005

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Naval Petroleum and Oil Shale Reserves

- **Four Petroleum and Three Oil Shale Reserves Created by Executive Order – December 1912 – 1927**
- **Current Authority - Naval Petroleum Reserves Act of 1976 – P.L. 94-258**
- **Transferred from the U.S. Navy to DOE Organization Act – July 1977**
- **Authorized Under Defense/Appropriated Under Interior and Related Committees**
- **Organized Under Strategic Petroleum Reserves – June 1999**
- **Current Oil Shale Program Established by Agreement Between U.S. Secretary of Energy and Estonian Minister of Economy – February 2000**

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Oil Shale History

- **Naval Petroleum Reserves - 1912**
- **DOI Leasing Program – 1974**
- **Synthetic Fuels Corp – 1979**
- **Colony Shuts Down – 1982**
- **Synthetic Fuels Program Abolished – 1985**
- **Unocal Shuts Down – 1991**
- **U.S./Estonia Program - 2000**

Abandoned Oil Shale Retort
Utah, circa 1900

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Mission

Increase Domestic Fuel Supply, Support National Security, and Create U.S. Jobs and Economic Growth Through Sustainable Development of the Vast Oil Shale Reserves of the United States

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Strategic Issues

- **World Oil Demand is Rising**
- **U.S. Energy and Economic Security is Increasingly at Risk**
- **World Oil Supply will Soon Peak and Decline**
- **Military Preparedness and Homeland Defense Requires Secure Fuel Sources**
- **Current Energy Policy Relies Heavily on Middle Energy Options are Limited**

America's Oil Shale Reserves Can Help Bridge the Gap

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Program Objectives

- **Review Status and Potential of Oil Shale in Context of Future Energy Supply Outlook**
- **Examine the Security and Economic Implications of Development**
- **Assess National and Public Benefits of Development**
- **Define Prospective Hurdles**
- **Identify Next Steps to Accelerate Development**

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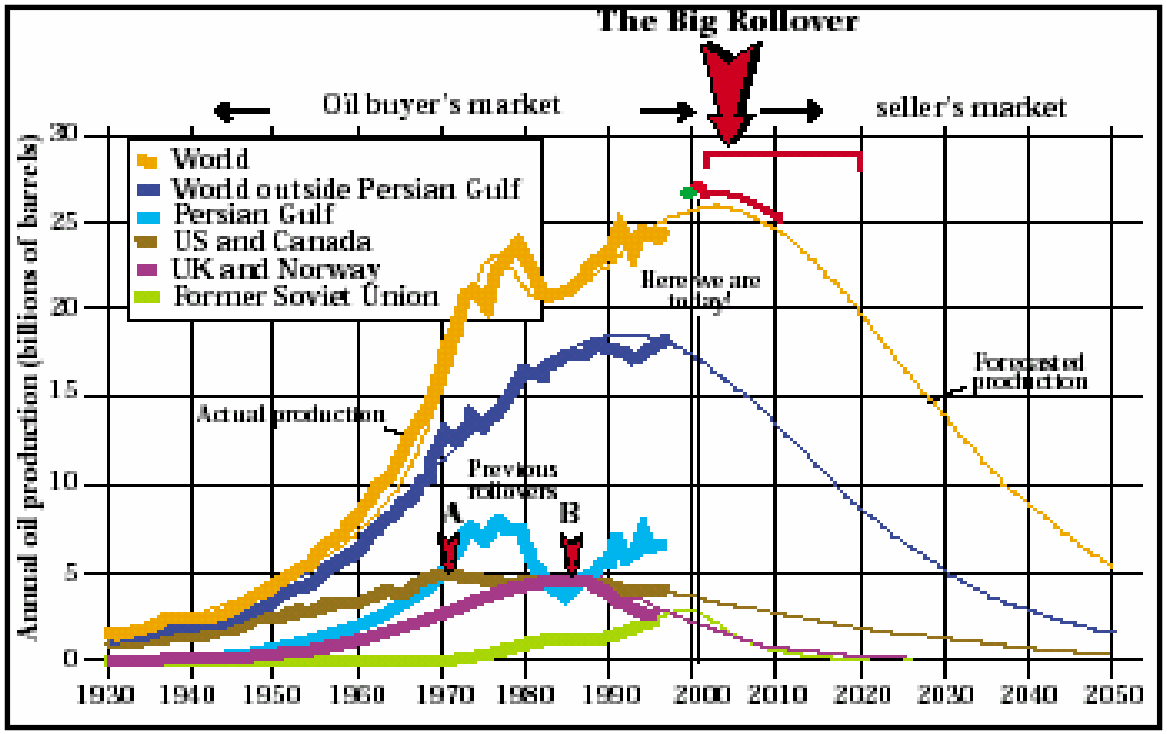
Cause for Concern?



Year of The Big Rollover	Forecaster
2003	Campbell, 1998
2004	Bartlett, 2000
2007	Duncan and Youngquist, 1999
2019	Bartlett, 2000
2020	Edwards, 1997
2010-2020	International Energy Agency, 1998

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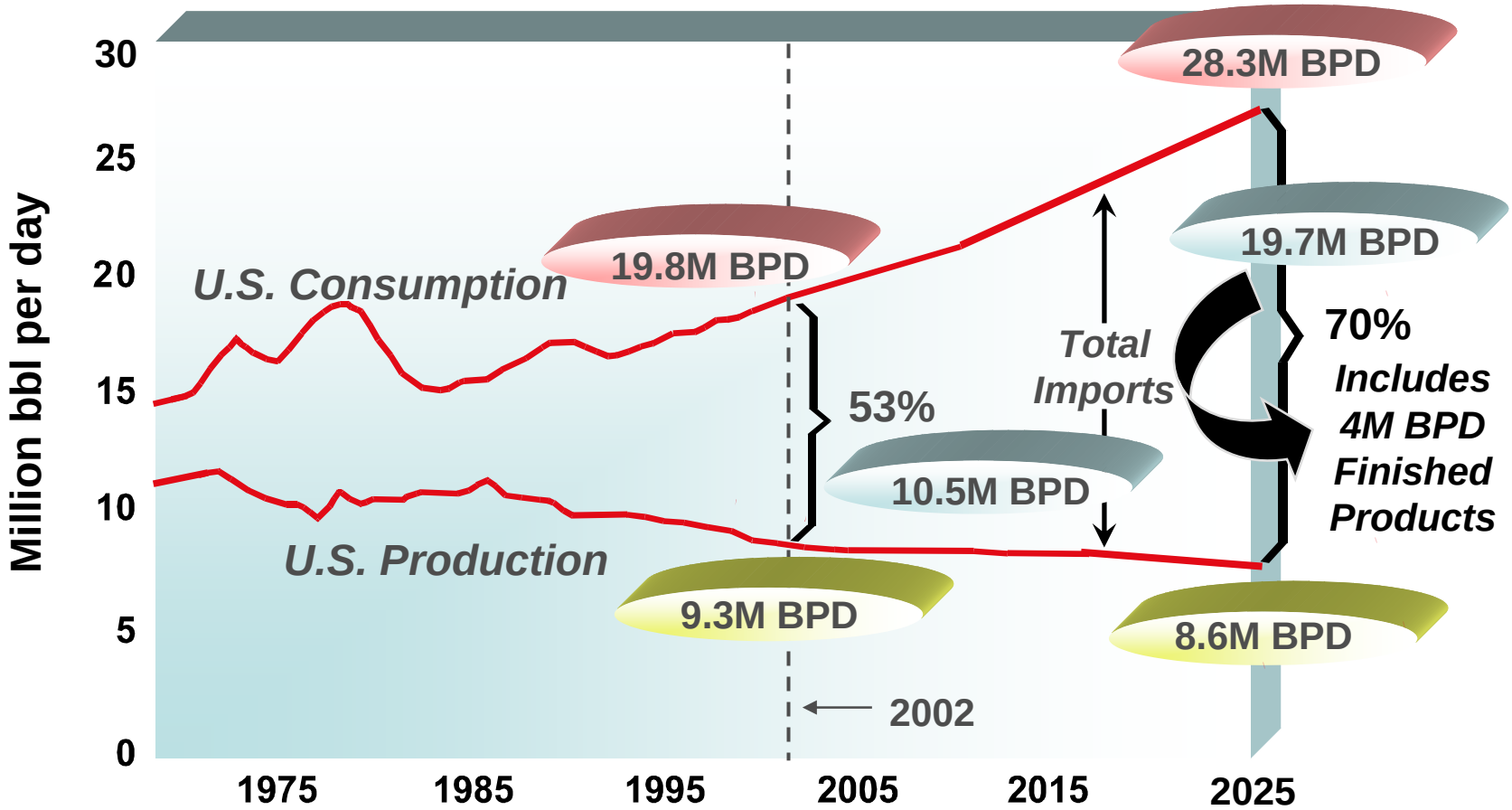
Increasing Reliance on Petroleum Imports



Source: EIA (AEO 2004); Reference Case Scenario [Courtesy John Winslow-DoE]

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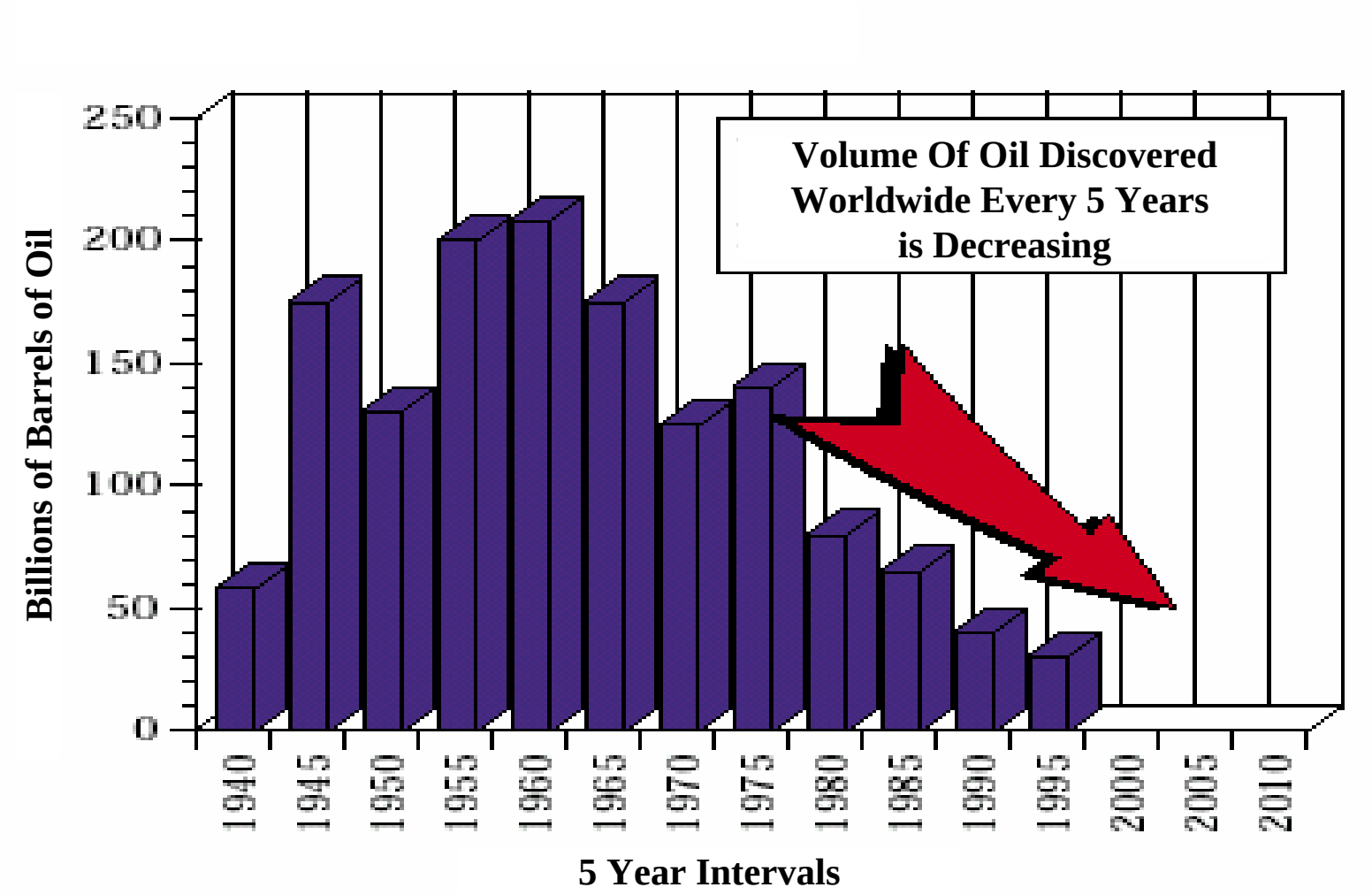
Discovered Oil – Billions of Barrels



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What Can We Do?

- **"Developing oil shale in the face of today's geopolitical risk and world production uncertainty is nothing less than a practical and relatively inexpensive insurance policy-a policy that may provide high dividends at a future time when a new policy would be prohibitively expensive to purchase."**

Dammer: August 9, 2004 Oil and Gas Journal

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U.S. Oil Shale Opportunity

- **Huge and Secure - 1 Trillion Barrels Recoverable**
  - **Largest Domestic Source of Transportation Fuels**
- **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**

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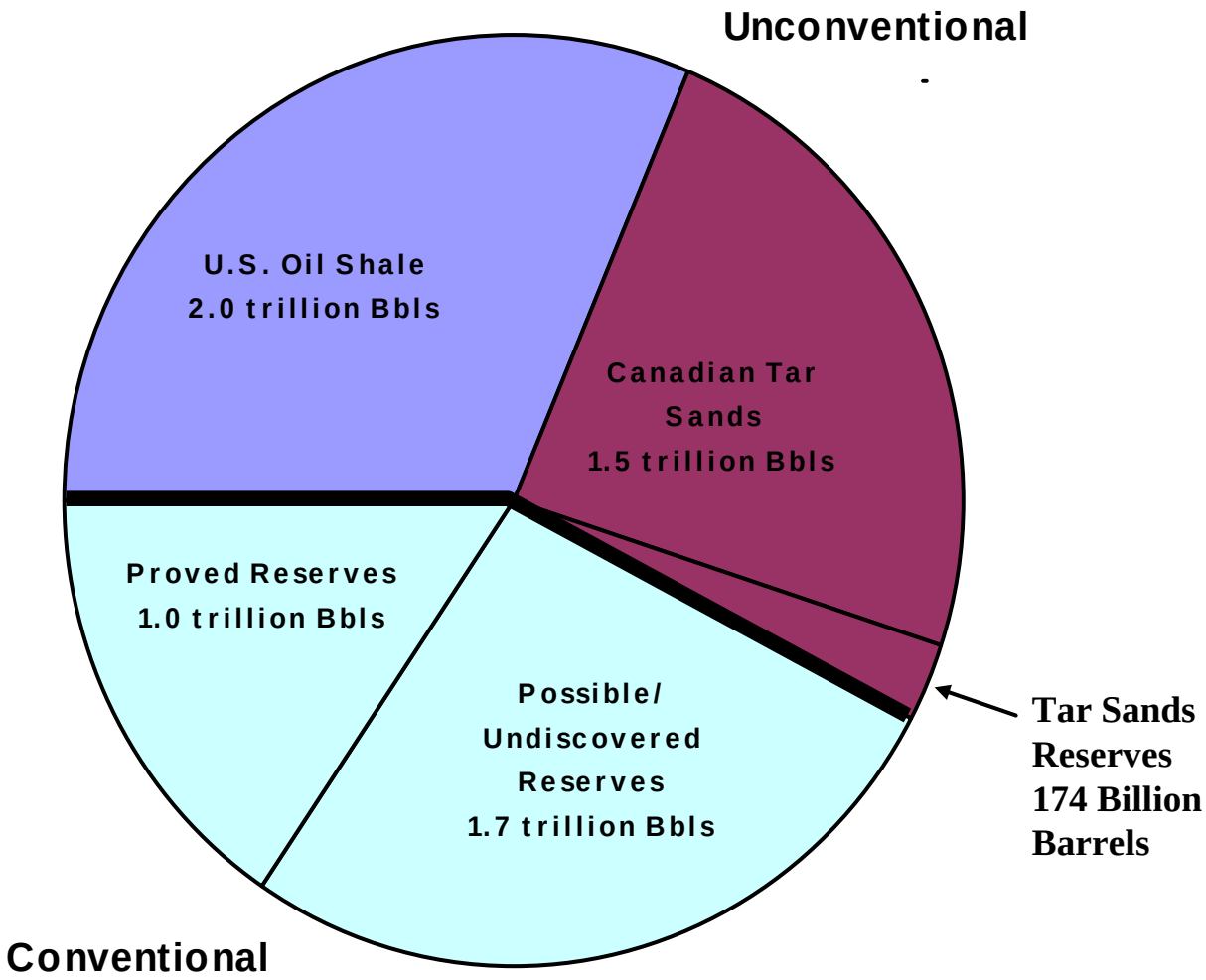
Unconventional Oil Resources Exceed World Conventional Resources



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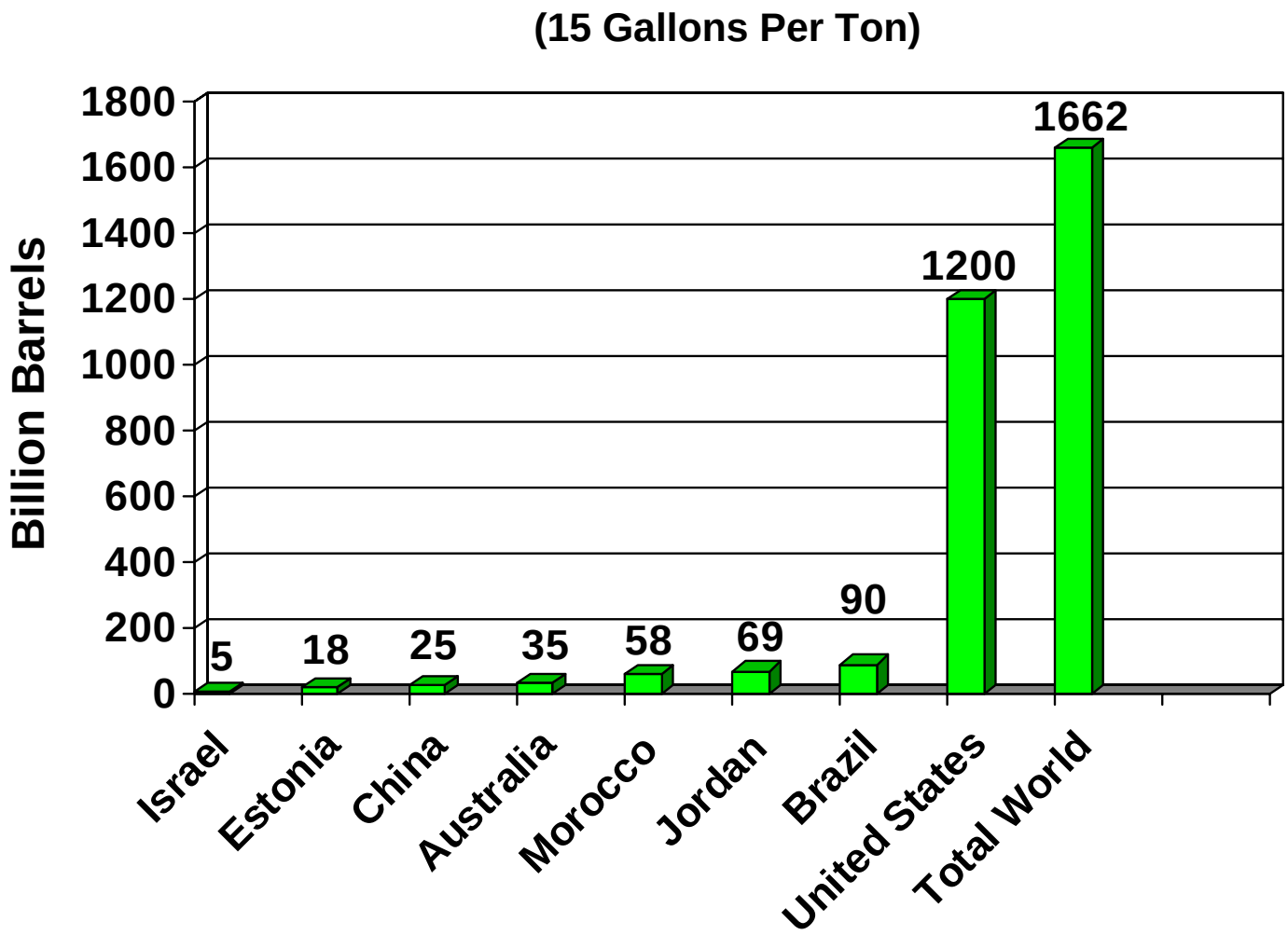
Major World Oil Shale Resources



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Current Activity

Country	Technology
Australia	ATP (Stuart Project)
Brazil	Petrosix
Canada	Water extraction/coking
China	Vertical Retort
Estonia	Galitor & Kiviter
Israel	Vertical Retort – R&D
Jordan	Active R&D Program
Mongolia	Active R&D Program
Morocco	Active R&D Program
Russia	Vertical Retort
Turkey	Active R&D
USA	Shell Exploration & Production Insitu

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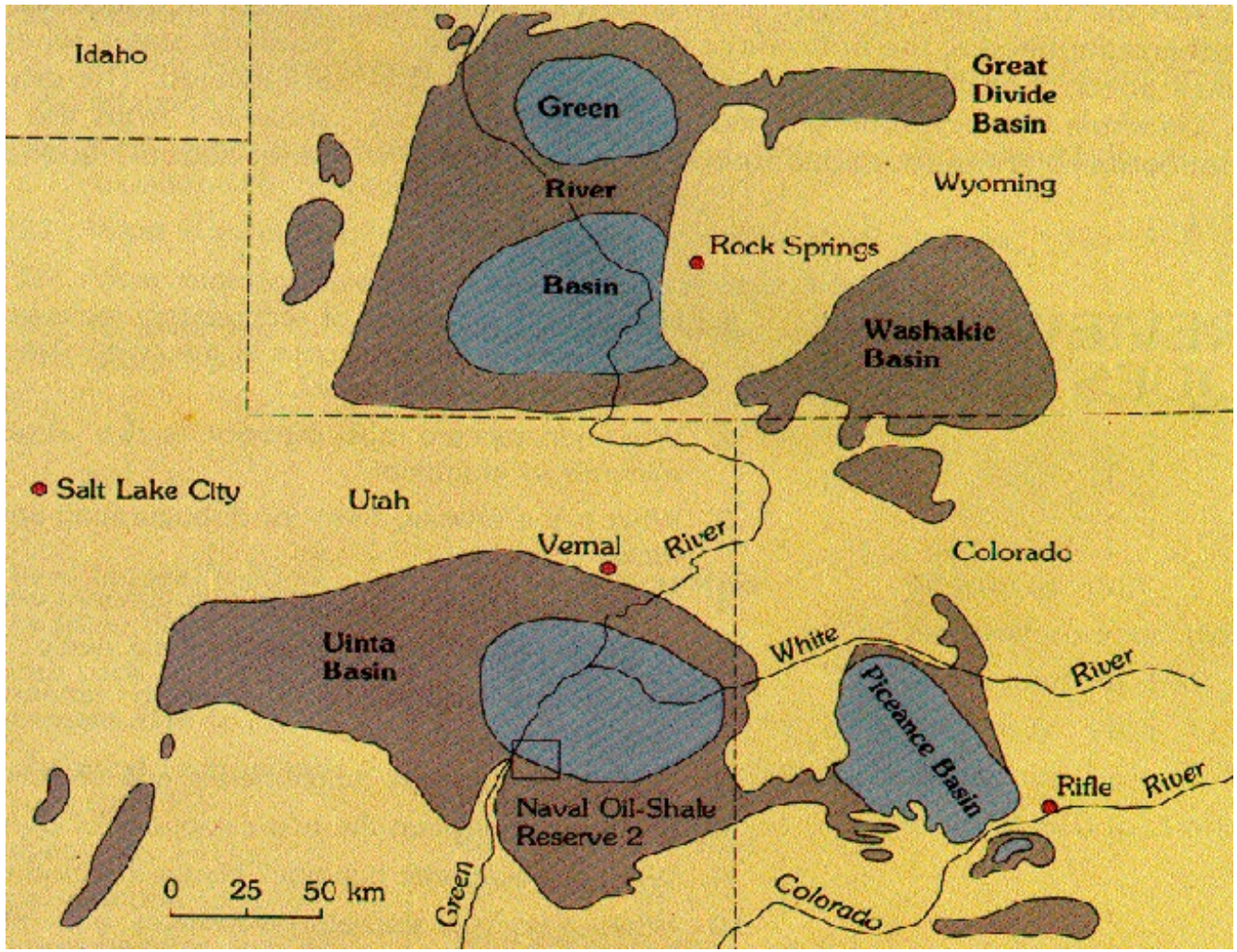
Distribution of Oil Shale in CO, UT and WY



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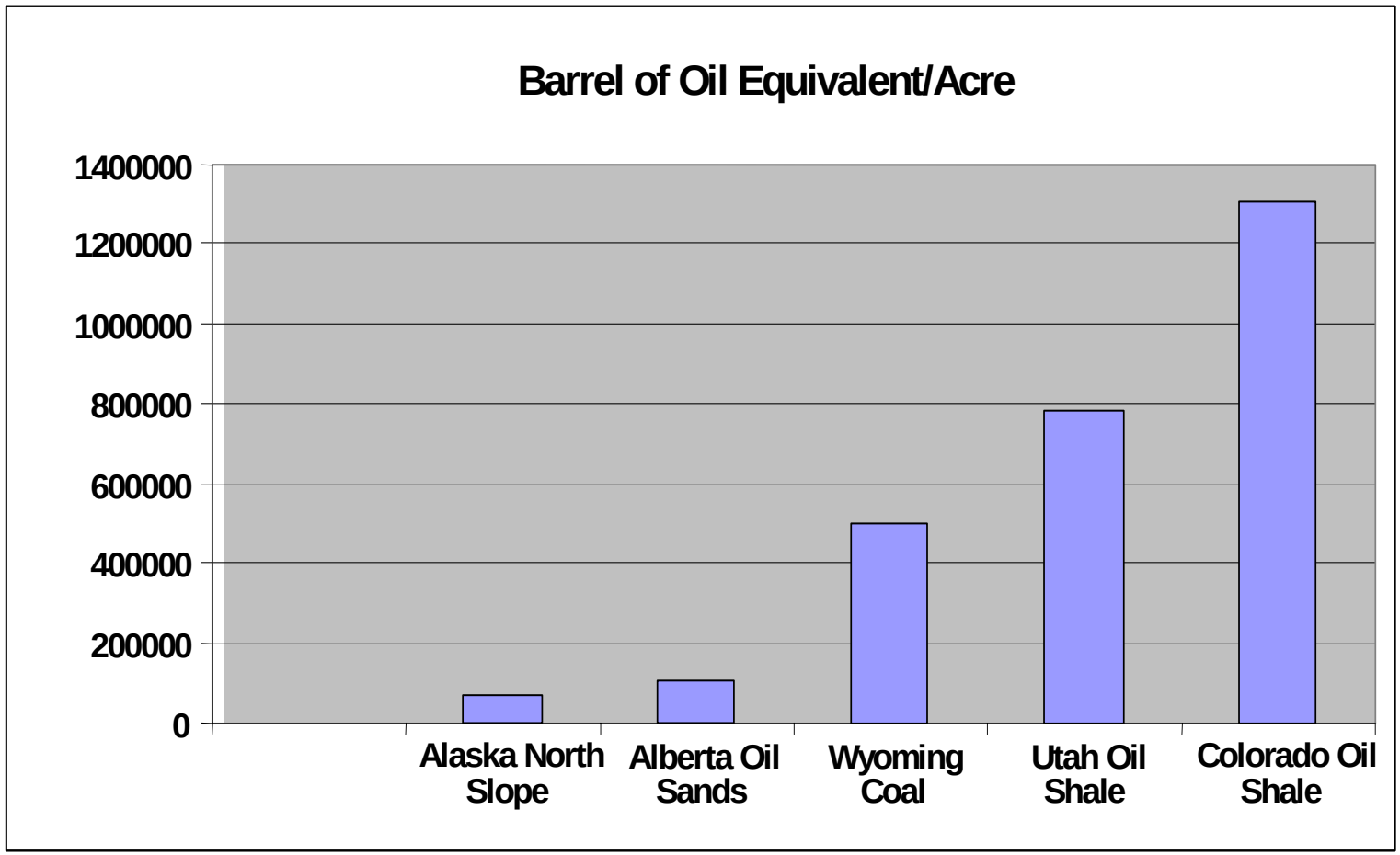
Energy Density of Selected Resources



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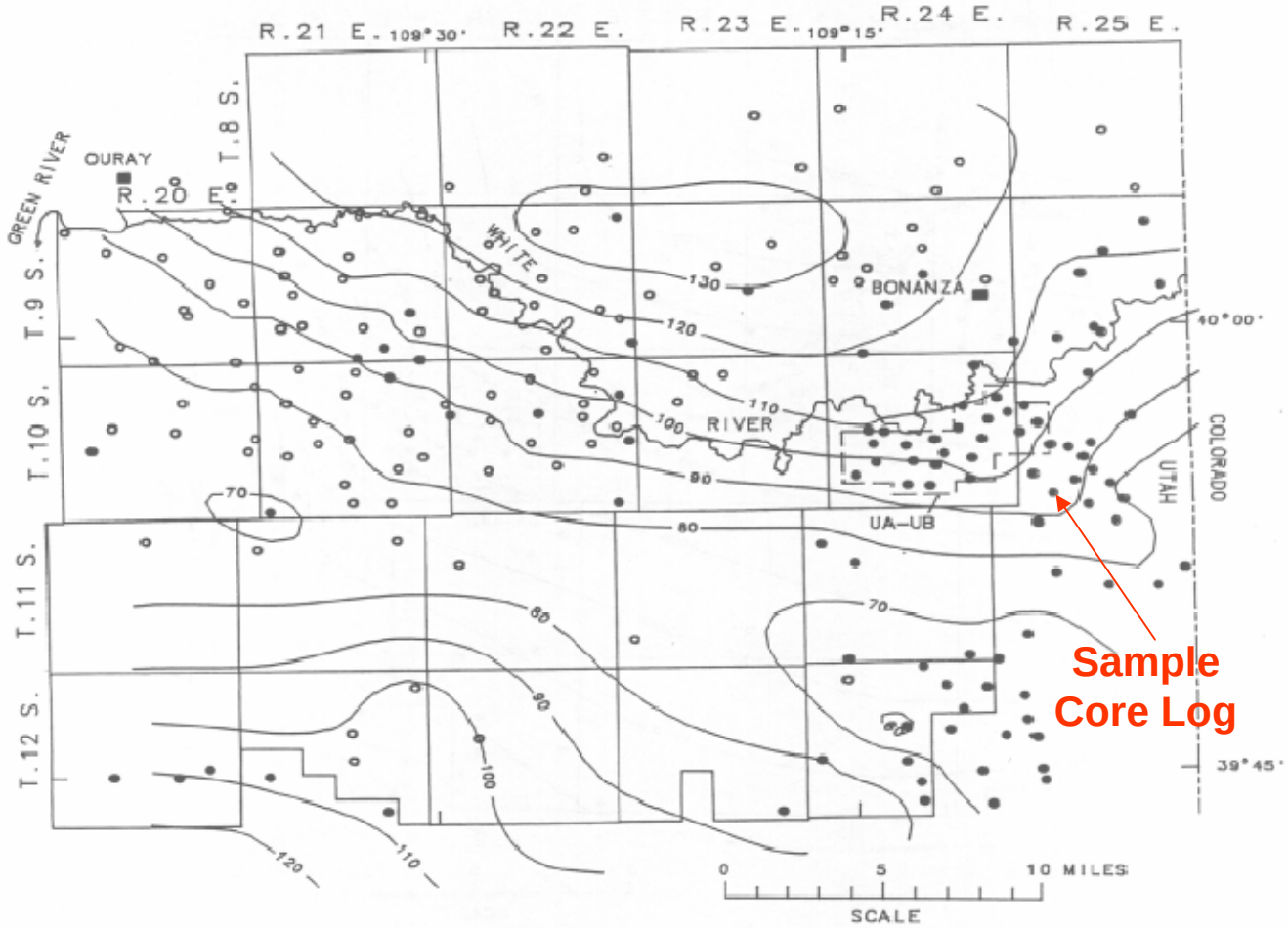
Utah 25 gpt Isopach (Interval 10 Feet)

300 Billion Barrels Recoverable



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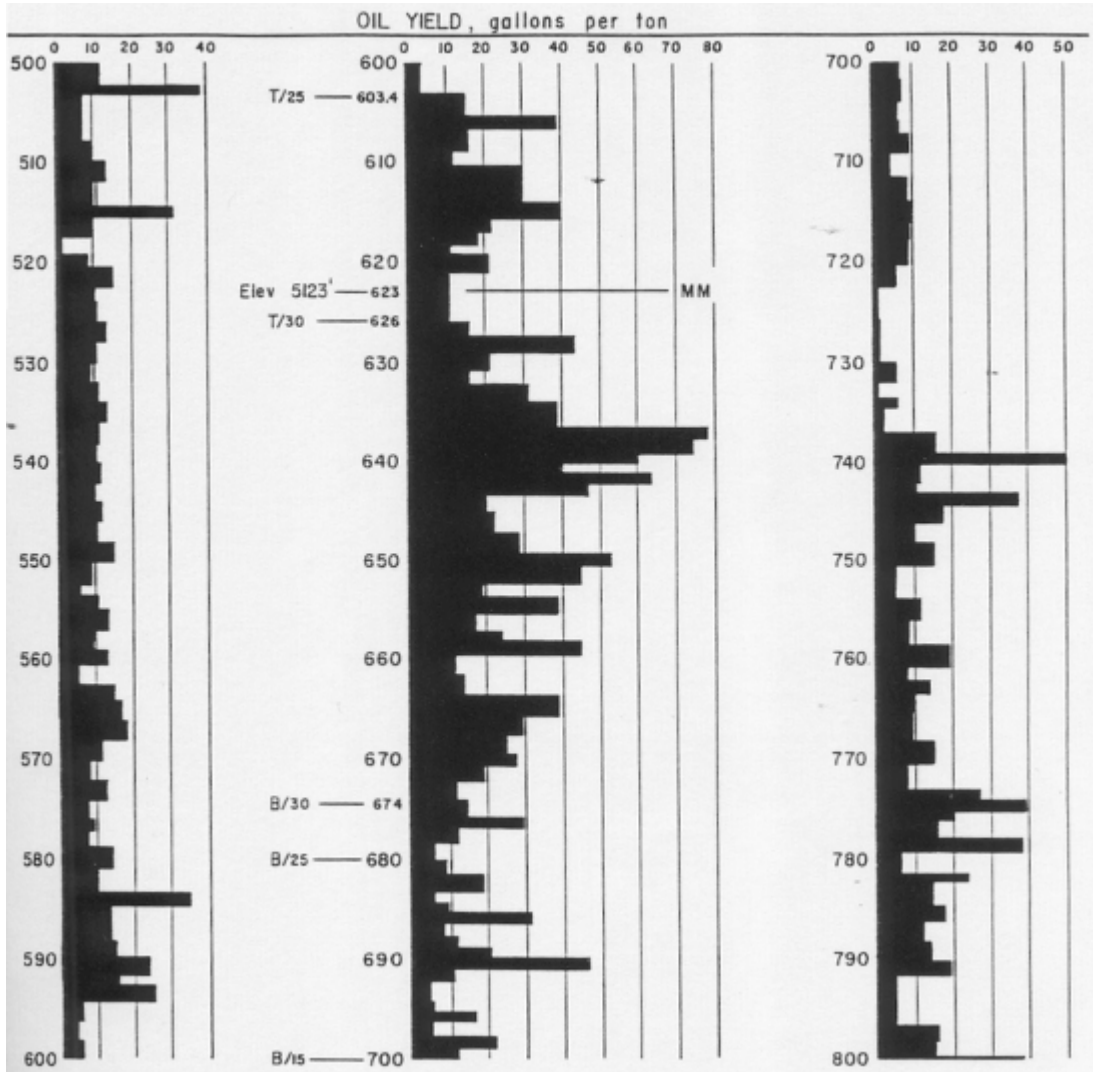
Utah Oil Shale Core Log



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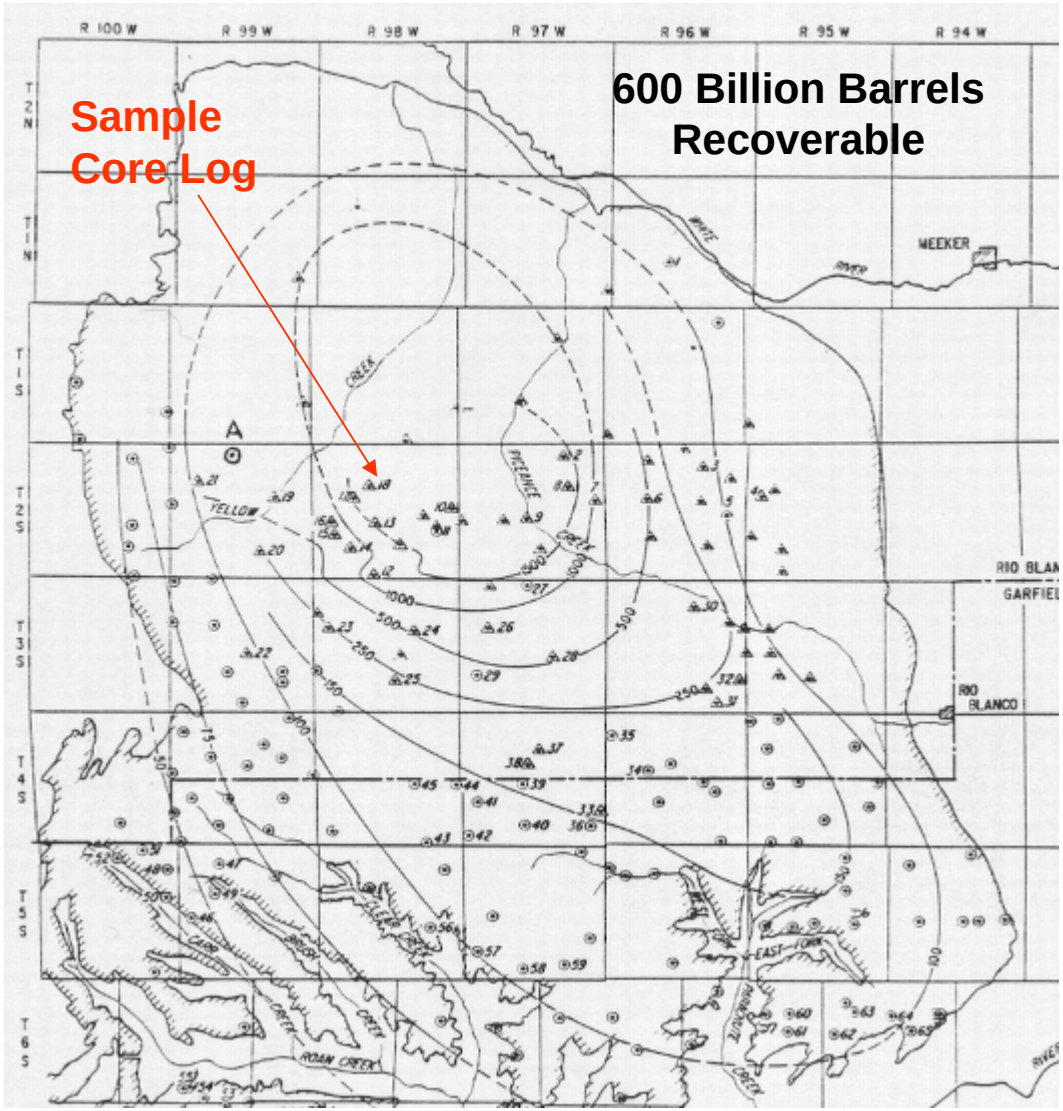
Colorado 25 gpt Isopach



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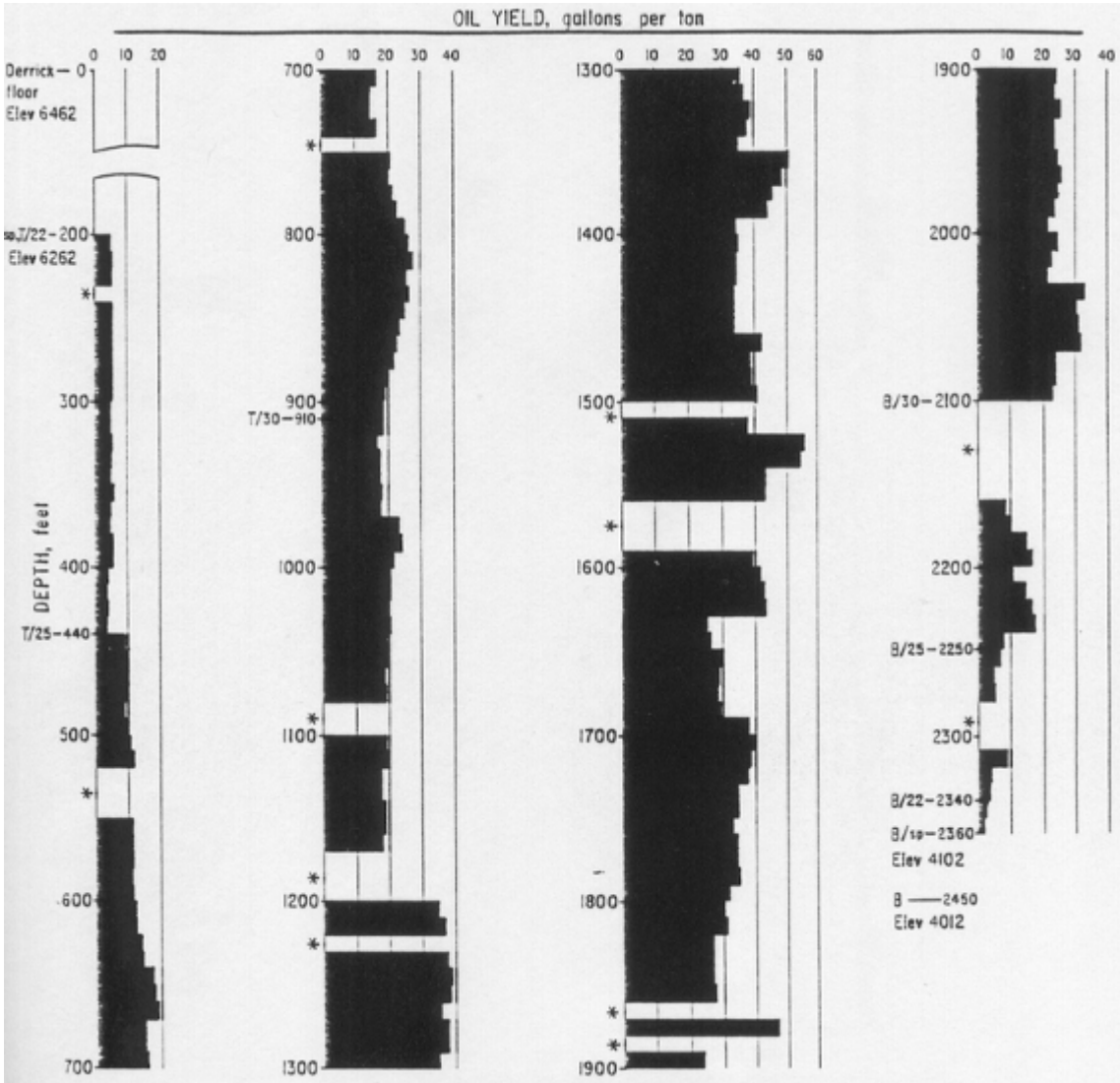
Colorado Oil Shale Core Log



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We Could be the New Middle East —1.6 Trillion Barrels

Old Middle East

Saudi Arabia:	261.8 Billion Barrels
Iraq:	112.5 Billion Barrels
UAE:	97.8 Billion Barrels
Kuwait:	96.5 Billion Barrels
Iran:	89.7 Billion Barrels
Qatar:	15.2 Billion Barrels
Oman:	5.5 Billion Barrels
Yemen:	4.0 Billion Barrels
Syria:	2.5 Billion Barrels
TOTAL	685.5 Billion Barrels

New Middle East

Shale:	1000 Billion Barrels
FT Coal:	500 Billion Barrels
Pet. Coke:	.15 Billion Barrels
Oil Reserves:	22.7 Billion Barrels
EOR Oil:	32 Billion Barrels
TOTAL	1.6 Trillion Barrels

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Characteristics of Oil Sand and Oil Shale Resources (Compared With Petroleum)

- **Reserves are Well Characterized – Essentially No Discovery Risks**
- **Uniform Quality – Very Little Variation in Product**
- **Long-Term Dependability – No Decline Curve**
- **High Recovery Efficiency – Little Uncertainty About Production**
- **Attractive Return on Investment – Alberta Oil Sands**

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Comparison of Principal Factors Influencing the Economics of Producing Refinery Crude Oil

Characteristic	Athabasca Oil Sands	Green River Oil Shale
Reserves	More Than 1 Trillion Bbls	More Than 1 Trillion Bbls
Grade (Richness)	25 Gallon Bitumen/Ton	30 Gallon Kerogen Oil/Ton
Hydrogen Content	10.5%	11.8%
N and S Requiring Removal	6.2 Wt%	4.6 Wt%
Loss of Liquids to Coke and Gas	40 Pounds/Ton-Ore	11.6 Pounds/Ton-Ore
Net Yield of Oil	0.53 Bbl/Ton Mined	0.73 Bbl/Ton Mined
Quality of Oil	34°API	38°API

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Oil Shale Product Yields

Product (% of Barrel)	Unocal	Bunger	Shell ICP
Gasoline	24/42	30/50	32/37
Jet Fuel	23/32	16/27	38/40
#2 Diesel	17/22	12/19	20/22
Gas Oil	36/0	42/0	10/0
Fuel Gas	(4)	(4)	(1)

Product percentages represent a barrel of upgraded kerogen oil through a two step process. The first step is distillation and the second step is distillation of cat cracker feed at the refinery.

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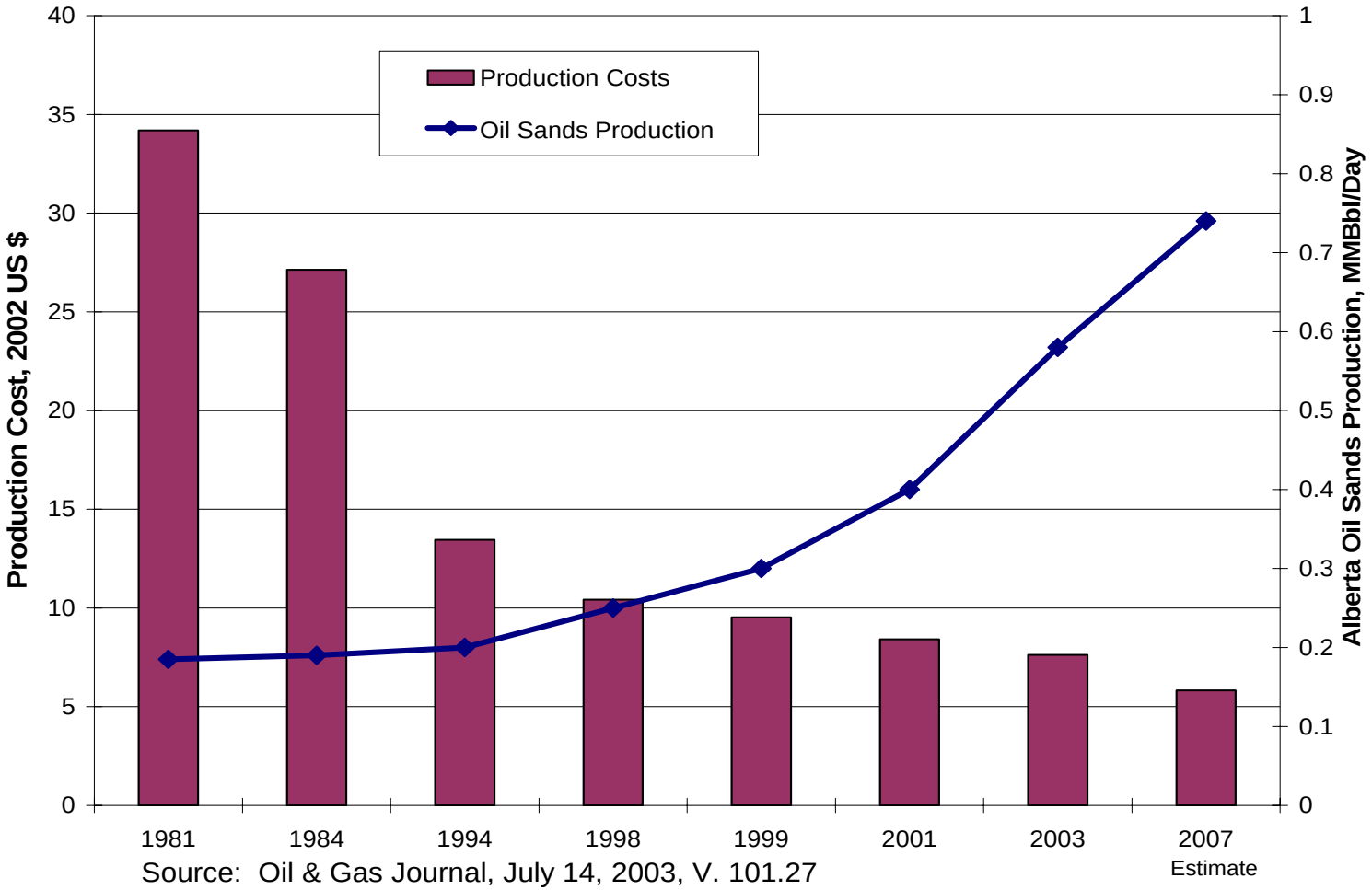
Tar Sand Economics and Production Continue to Improve



Source: Oil & Gas Journal, July 14, 2003, V. 101.27

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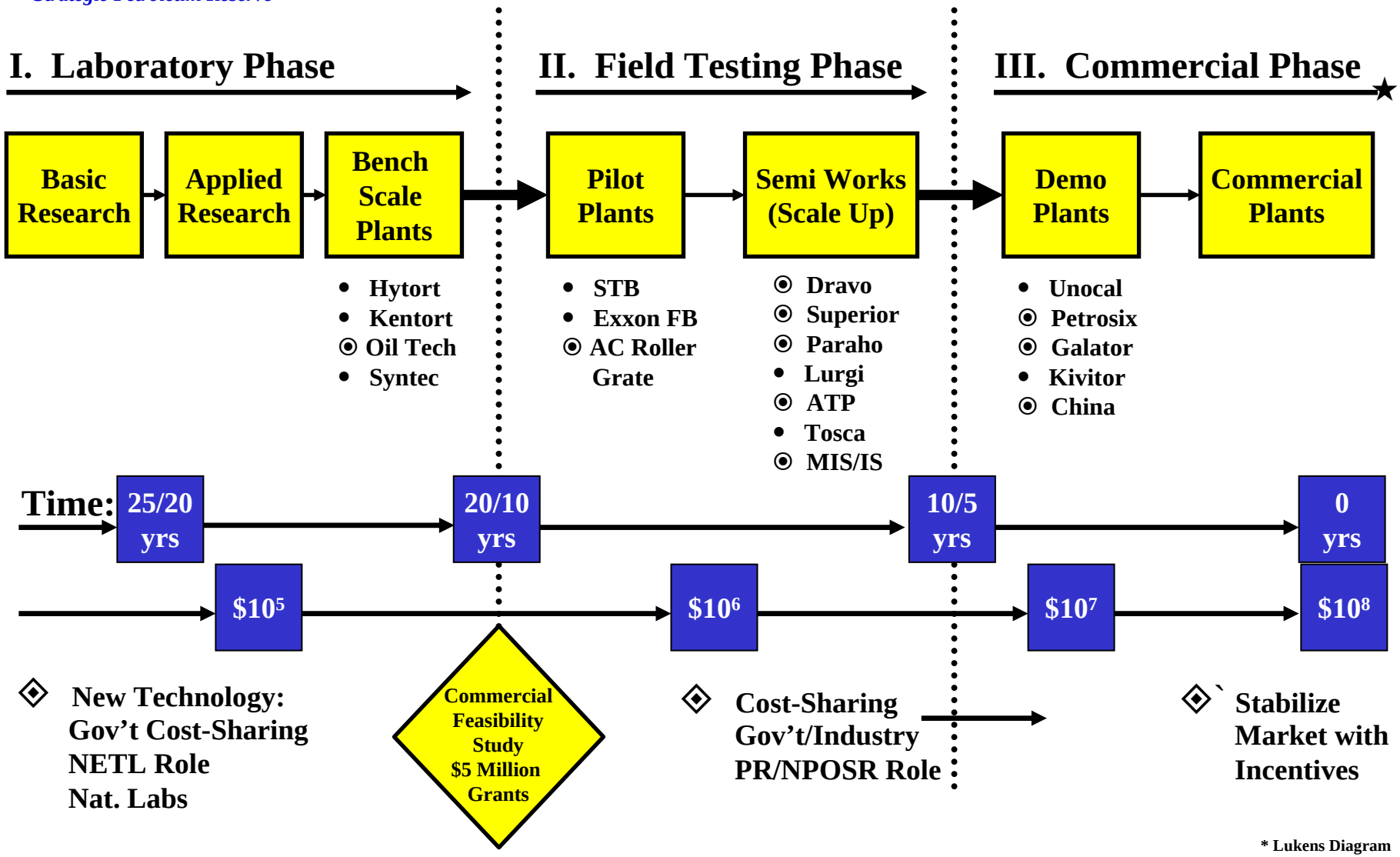
Oil Shale Commercialization Process



* Lukens Diagram

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Status of Strategic Planning Program

Oil Shale May Complement the Strategic Petroleum Reserve

- **"Strategic Significance" Peer Review Meeting– Feb 2004**
- **Final "Strategic Significance" Report – April 2004**
- **Alberta Oil Sands Field Trip - Sept. 2004**
- **Oil Shale Steering Group Meetings – April, July, Oct 2004 and January, 2005**
- **Oil Shale Roadmap – Dec 2004**
- **Draft Development Plan and Peer Review – March, 2005**
- **Development Plan and Report to Congress – May 1, 2005**

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Next Step

- **Complete a Development Plan and Assure Adequate Representation of:**
  - **Economic and Investment Costs and Risk**
  - **Technology Readiness and Advancement**
  - **Access to Oil Shale Resources on Federal Lands**
  - **Environmental / Regulatory Compliance**
  - **Infrastructure Requirements**
  - **Stakeholder Issues and Concerns**
  - **International Activities Assessment**
  - **Socioeconomic Requirements**

- **Propose a Joint Industry / Government Program**

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Oil Shale Supports National Energy Policy

- ***Increase Domestic Energy Supplies***: Oil Shale is the Largest Fossil Fuel Resource in the U.S. – Estimated to be 1.0 Trillion Barrels of Recoverable Reserves. Greater Than World Proved Reserves.

- ***Enhancing National Energy Security***: Development of Domestic Oil Shale in Colorado, Utah, and Wyoming Could Potentially Reverse Our Growing Imports of Foreign Supplies...Supplies Which Depend on the Economic Well-being and Political Stability of Countries Located in Some of the Most Volatile Areas in the World. Development of This Rich Domestic Resource will not Occur Overnight. The U.S. Should Begin the Work Necessary to Assure Readiness in This Critical Area.

- ***Protecting America's Environment***: Technology in Oil Shale Extraction, Processing, and Disposal Have Evolved Considerably Over the Past Two Decades. Processes are More Efficient, Less Energy and Water Consumptive, and Less Environmentally Damaging Than in the Past.

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Direction 2005

"During the next four years, we will continue to enhance our economic security and our national security through sound energy policy. We will pursue more energy close to home, in our own country and in our own hemisphere, so that we're less dependent on energy from unstable parts of the world. And we will continue to work closely with Congress to produce comprehensive legislation that moves America toward greater energy independence."

President Bush – On the nomination of Secretary Bodman
Dec., 10, 2004

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The Next Strategic Petroleum Reserve