TAKING RECOVERY GROWTH SERIOUSLY

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TAKING THE ‘S’ SERIOUSLY

IT’S THE ASPO,

NOT

- THE AIPO,

- THE APPO, OR

- THE APDPO

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‘WE ARE ALL PEAKISTS NOW’

- JAMES SCHLESINGER

‘BUT WHAT TYPE OF PEAKISTS ARE WE?’

- RICHARD NEHRING

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TWO TYPES OF PEAKISTS

- **IMMINENT PEAKISTS**
  - **PEAK REACHED 2005-2015, AT BEST A SHORT (5-10 YR) PEAK PLATEAU**

- **DELAYED PEAKISTS**
  - **PEAK REACHED 2020-2040, A LONGER (15-30 YR) PEAK PLATEAU**

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WHAT'S THE BIG DEAL?

- SEEMINGLY SMALL DIFFERENCES
  - 10-30 YEARS UNTIL THE PEAK
  - 5-15 MM B/D PRODUCTION AT PEAK

- ONLY THE DIFFERENCE BETWEEN CATASTROPHE AND A DIFFICULT BUT MANAGEABLE TRANSITION

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WHY DO THESE TWO TYPES DIFFER?

- ‘THE USUAL SUSPECTS’
  - PSYCHOLOGICAL
  - PROFESSIONAL BACKGROUND
- THE ESSENTIAL DIFFERENCE
  - DIFFERENT ASSESSMENTS OF WORLD OIL RESOURCES

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ULTIMATE WORLD OIL POTENTIAL

	Low	Medium	High
	(billion barrels)		
Cumulative Production	1080	1080	1080
Proved Dev. Reserves	715	715	715
Recovery Growth	790	1120	1490
Future Discoveries	480	700	1000
Unconventional	320	500	750
WORLD TOTAL	3385	4115	5035

ULTIMATE WORLD OIL POTENTIAL

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RECOVERY GROWTH	----	----	----
Future Discoveries	480	700	1000
UNCONVENTIONAL	----	----	----
WORLD TOTAL	2275	2495	2785

WHY DO WORLD OIL ASSESSMENTS DIFFER SO RADICALLY?

- **Not about facts of world oil occurrence and discovery**

- **Major conceptual difference**
  - **Recovery growth is central to delayed peakists**
  - **Recovery growth is immaterial to imminent peakists**

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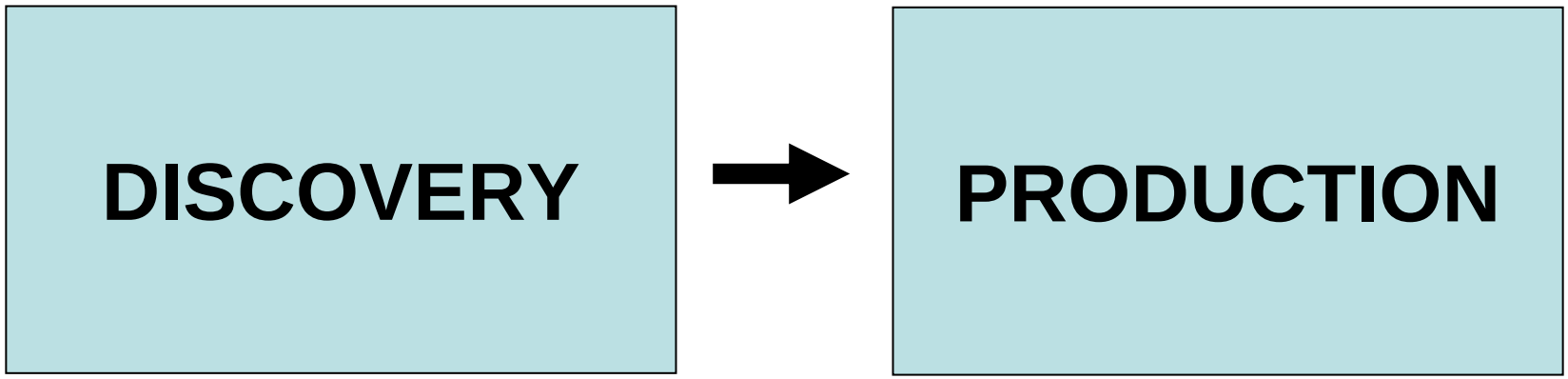
HOW IMMINENT PEAKISTS VIEW THE WORLD



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HOW DELAYED PEAKISTS VIEW THE WORLD

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WHAT IS RECOVERY GROWTH?

- **The Cinderella of oil and gas**
  - **Largely ignored and neglected**
  - **Provides the majority of recent reserve additions**
- **Studied by only a few**
- **A reality in search of a method**

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WHAT IS RECOVERY GROWTH? (2)

- The change in estimates of ultimate recovery of oil and gas in discovered fields over time

- Two types of changes
  - Changes of in-place estimates (plus or minus)
  - Increased recovery efficiency of the in-place resource (plus)

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WHY DOES RECOVERY GROWTH OCCUR?

- **Past development was usually constrained**
  - **Economically**
  - **Technologically**
  - **Data**
  - **Political/regulatory**

- **When these constraints are relaxed, field development proceeds and ultimate recovery increases**

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WORLD RECOVERY GROWTH POTENTIAL

- 790-1120-1490 billion barrels
- Ultimate recovery factors of 35-40-45% of c. 7.0 trillion barrels in place
- 45-50% of world oil potential
- Nearly 300 billion barrels in fields under development plus (with massive overlap) 500 billion barrels of proved and probable undeveloped reserves

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HOW WILL THIS GROWTH OCCUR?

- Future growth will differ in kind from past growth
- Three main types of growth
  - Development of discovered fields
  - More intensive IOR
    - Reduced well spacing
    - More horizontal and multilateral drilling
    - Advanced secondary recovery
  - Broader application of EOR

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THE TRANSFORMATION OF THE UPSTREAM DISCIPLINES AND GROWTH

- **GEOLOGY**
  - Development geology & reservoir characterization
- **GEOPHYSICS**
  - 4-D seismic (seeing bypassed pay)
- **PETROLEUM ENGINEERING**
  - Integrated reservoir management
  - Horizontal & multilateral drilling
  - Drilling architecture
  - Smart completions

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RECOVERY GROWTH AND THE FUTURE OF WORLD OIL PRODUCTION

- Recovery growth increases ultimate world resources significantly
- But this increase will occur slowly

- Only a modest effect on the maximum level of world oil production
- A very significant effect on how long high levels of world oil production can last

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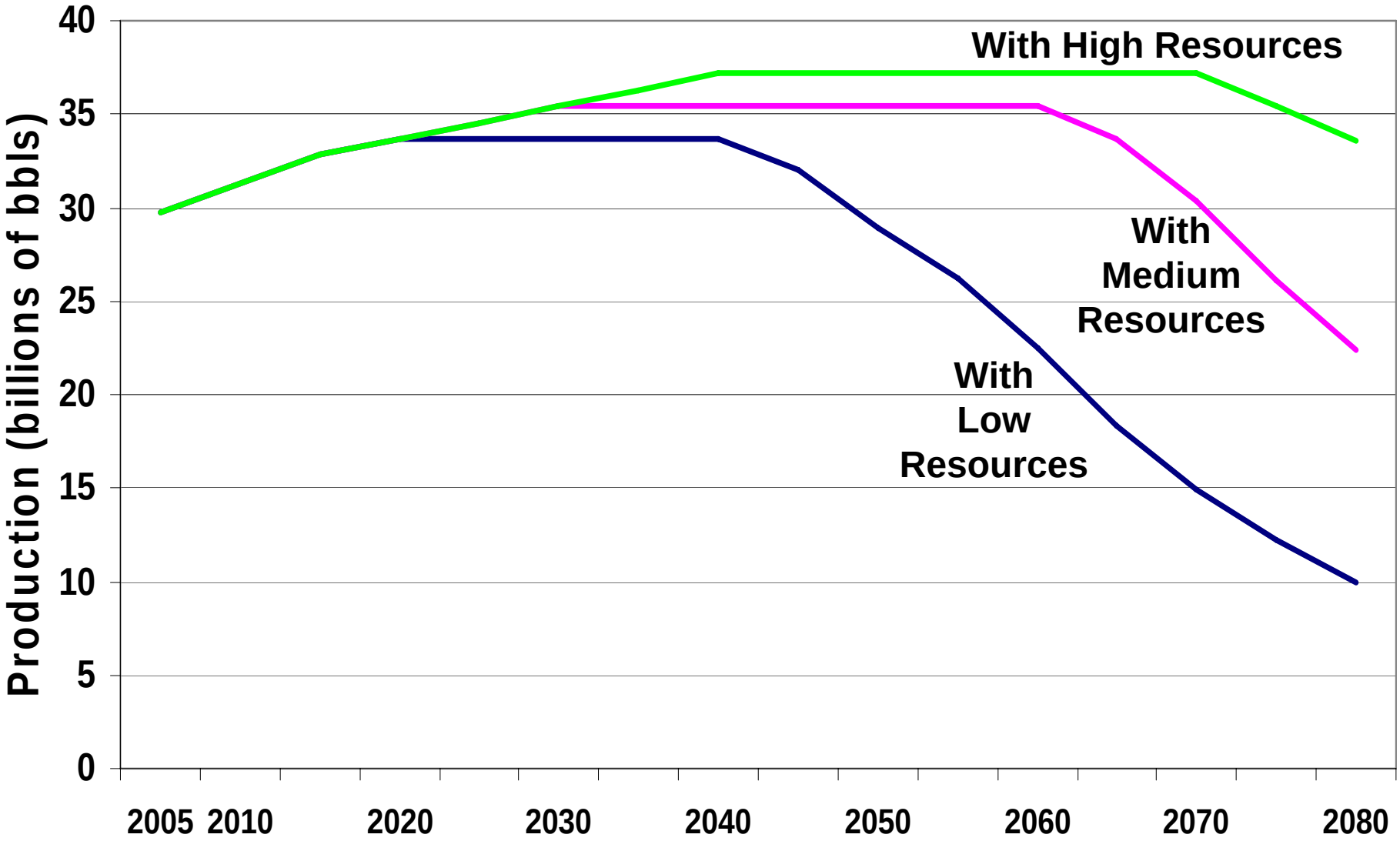
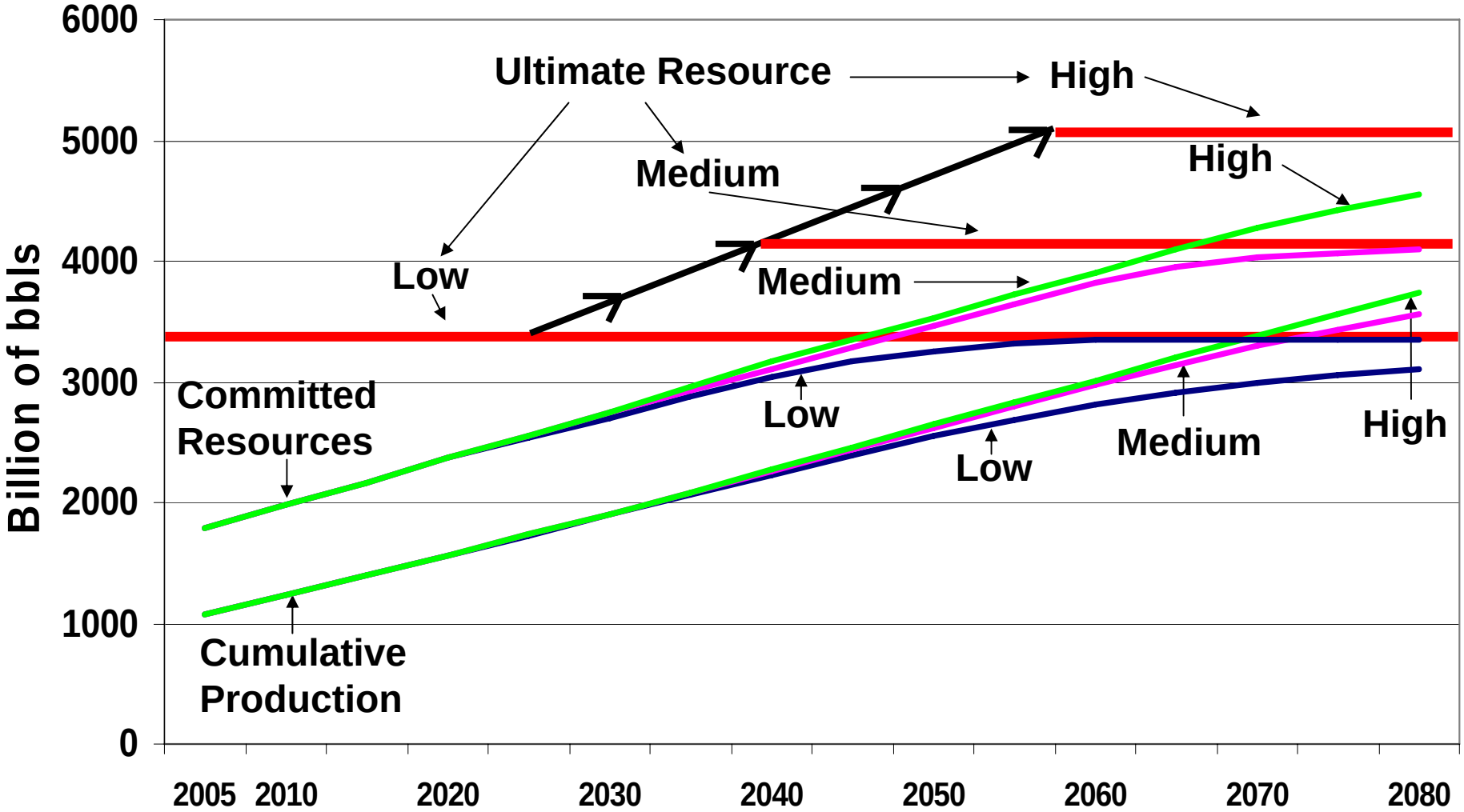
FUTURE WORLD OIL PRODUCTION – FINAL CONSTRAINED PROJECTIONS



FINAL PROJECTIONS: CUMULATIVE PRODUCTION & COMMITTED RESOURCES, 2005-2080



CRITIQUES OF RECOVERY GROWTH

(1) Lacks a rigorous methodology and a validated predictive theory

- True, relies primarily on analogical reasoning
- But, this is a case where theory needs to catch up with our experience
- This experience trumps the current lack of theory

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CRITIQUES OF RECOVERY GROWTH

(2) Recovery growth costs more

- True, but irrelevant
- Essentially backward-looking
- Relevant forward-looking comparisons focus on (a) the price of oil and (b) the cost of substitutes to conventional oil
- And the winner is – recovery growth!

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CRITIQUES OF RECOVERY GROWTH

(3) Using historic growth factors grossly overstates potential

- True, but best current estimates of future recovery growth do not use these
- Historic growth factors predict 5X to 8X growth from initial estimate
- Current estimates imply only 1.5X to 2.5X growth from initial estimates

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TAKING RECOVERY GROWTH SERIOUSLY

- **The major source of future additions to known world oil resources**
- **No panacea – it does not eliminate the problems of peak oil**
- **One of the most effective strategies for making the problems of peak oil manageable and tolerable**

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GO ROCKIES!

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2007 Houston World Oil Conference

Proceedings

- Conference Program
- Conference DVD
- Video Highlights
- Peak Oil Review
- ASPO-USA