The Impact of Petroleum Technology Advances on Long-Term Energy Markets

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Energy Information Administration

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Highlights

- Technological advances affect all sectors of the energy market and all regions of the world
- The competitive, global petroleum industry promotes worldwide technology transfer
- Technological advances support economic development and growth
- Technological advances are inevitable but are hard to predict – need is the mother of invention

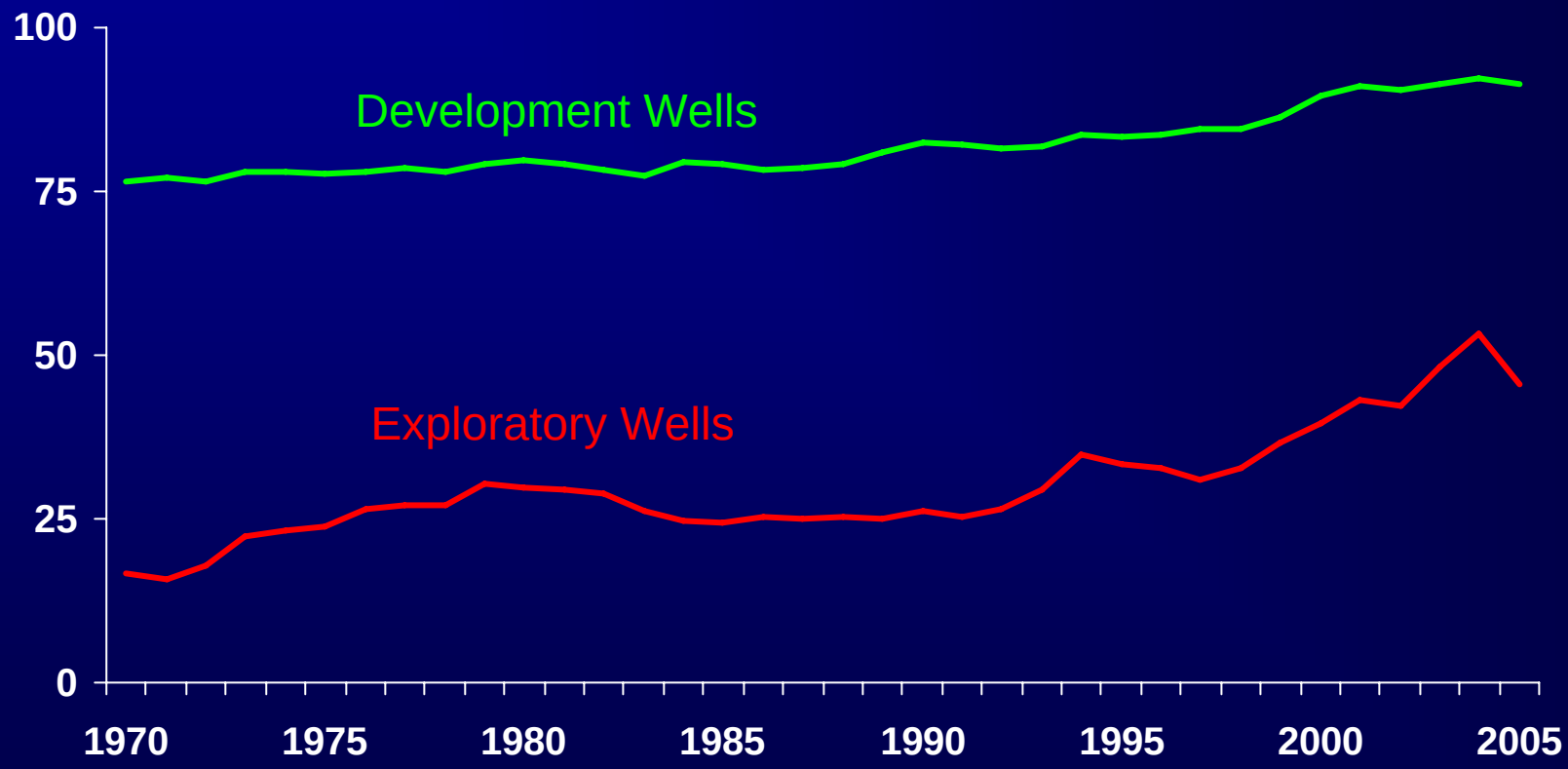
The Past is Prologue

- Past technological advances have affected energy supply, demand, and production costs

- Past supply-side technology advances:
  - Coal mining
  - Oil and natural gas production
  - Electric generation

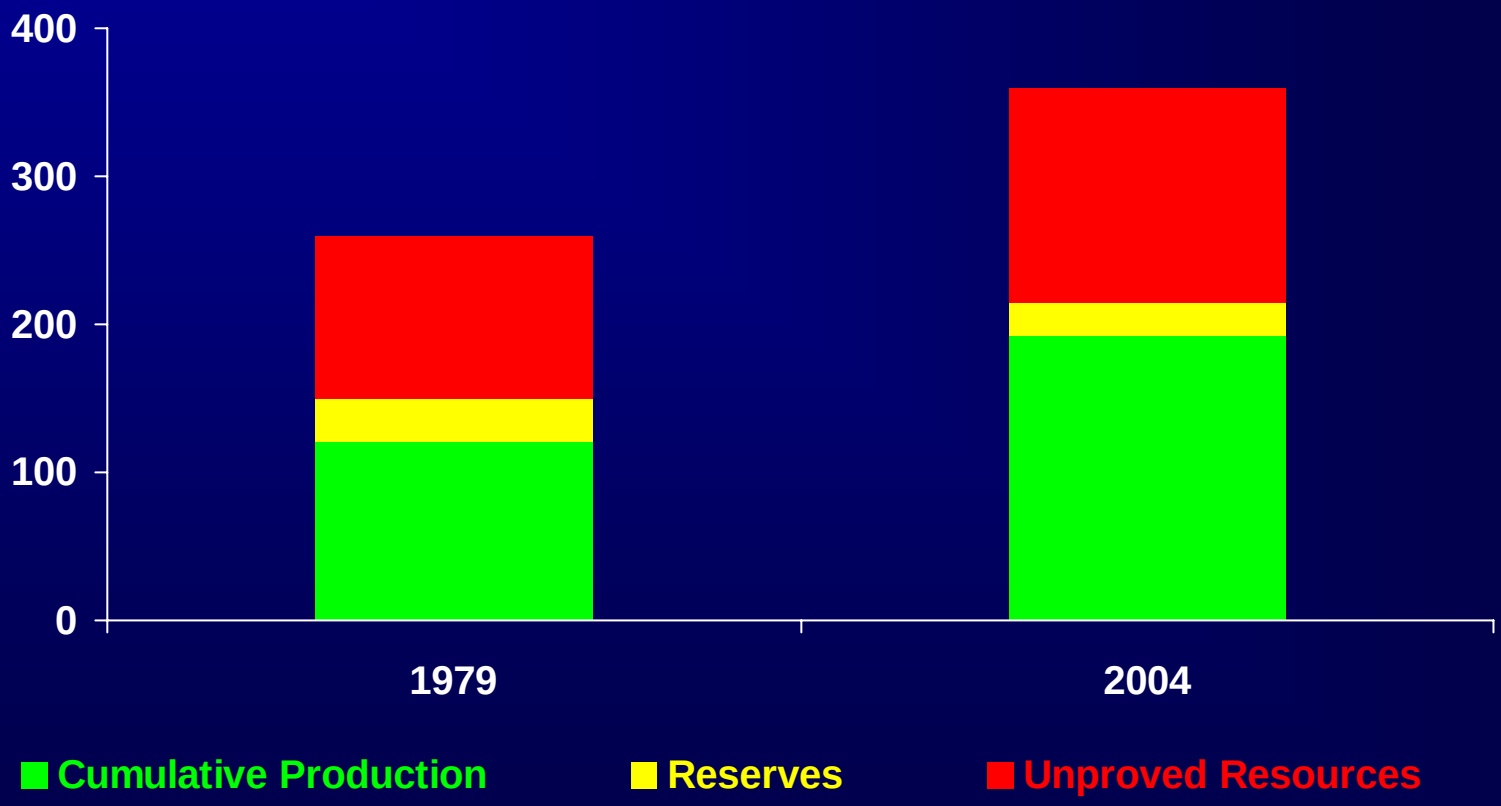
- Past end-use technology advances:
  - Residential and commercial buildings sectors
  - Transportation sector
  - Industrial sector

U.S. Oil and Natural Gas Well Success Rates, 1970-2005 (successful percentage of total wells drilled)



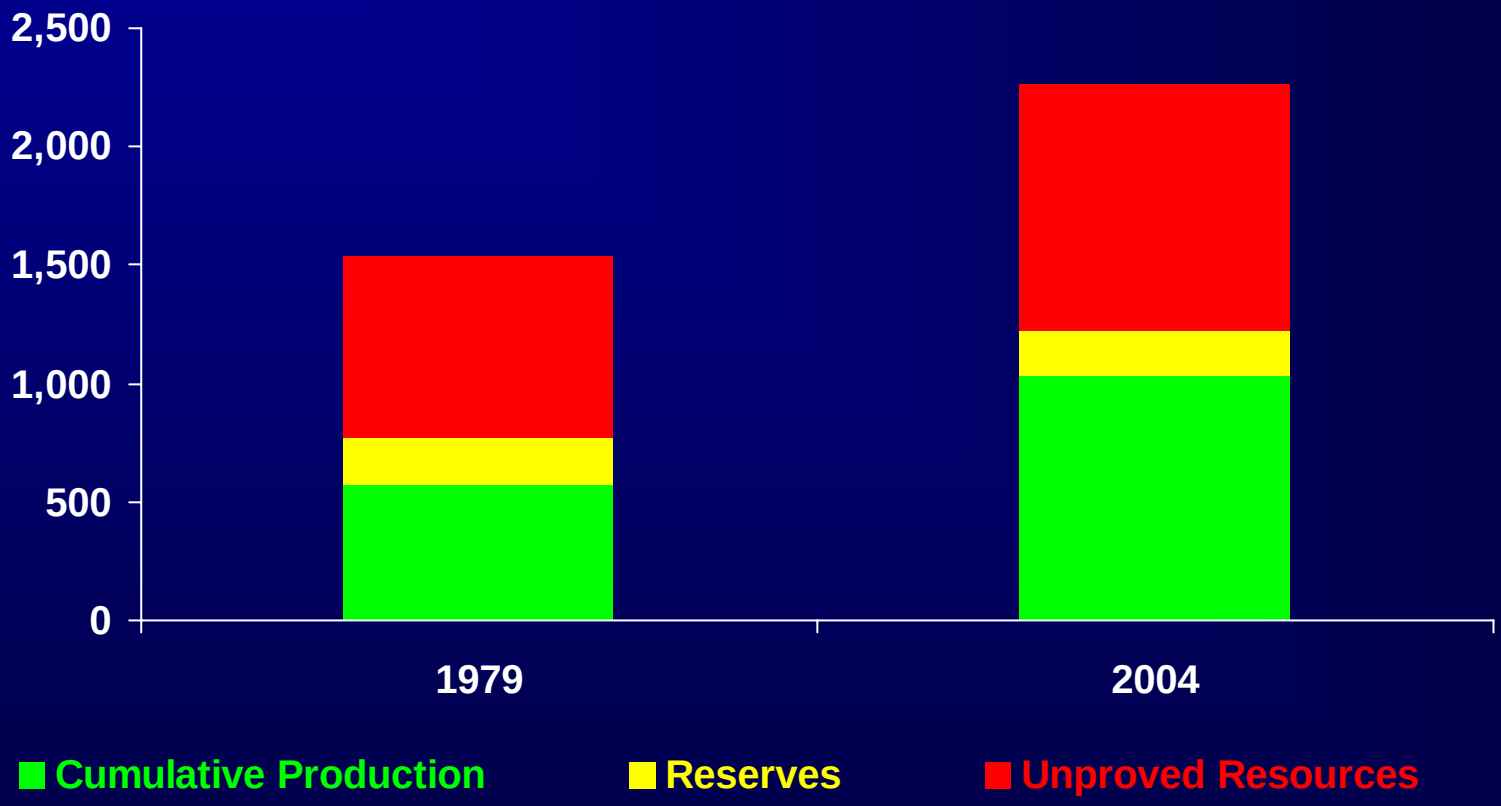
Annual Energy Review 2005

Mean Estimate of Ultimately Recoverable U.S. Crude Oil, Year-End 1979 and 2004 (billion barrels)



U.S. Geological Survey, Minerals Management Service, and Energy Information Administration

Mean Estimate of Ultimately Recoverable U.S. Natural Gas, Year-End 1979 and 2004 (trillion cubic feet)



U.S. Geological Survey, Minerals Management Service, and Energy Information Administration

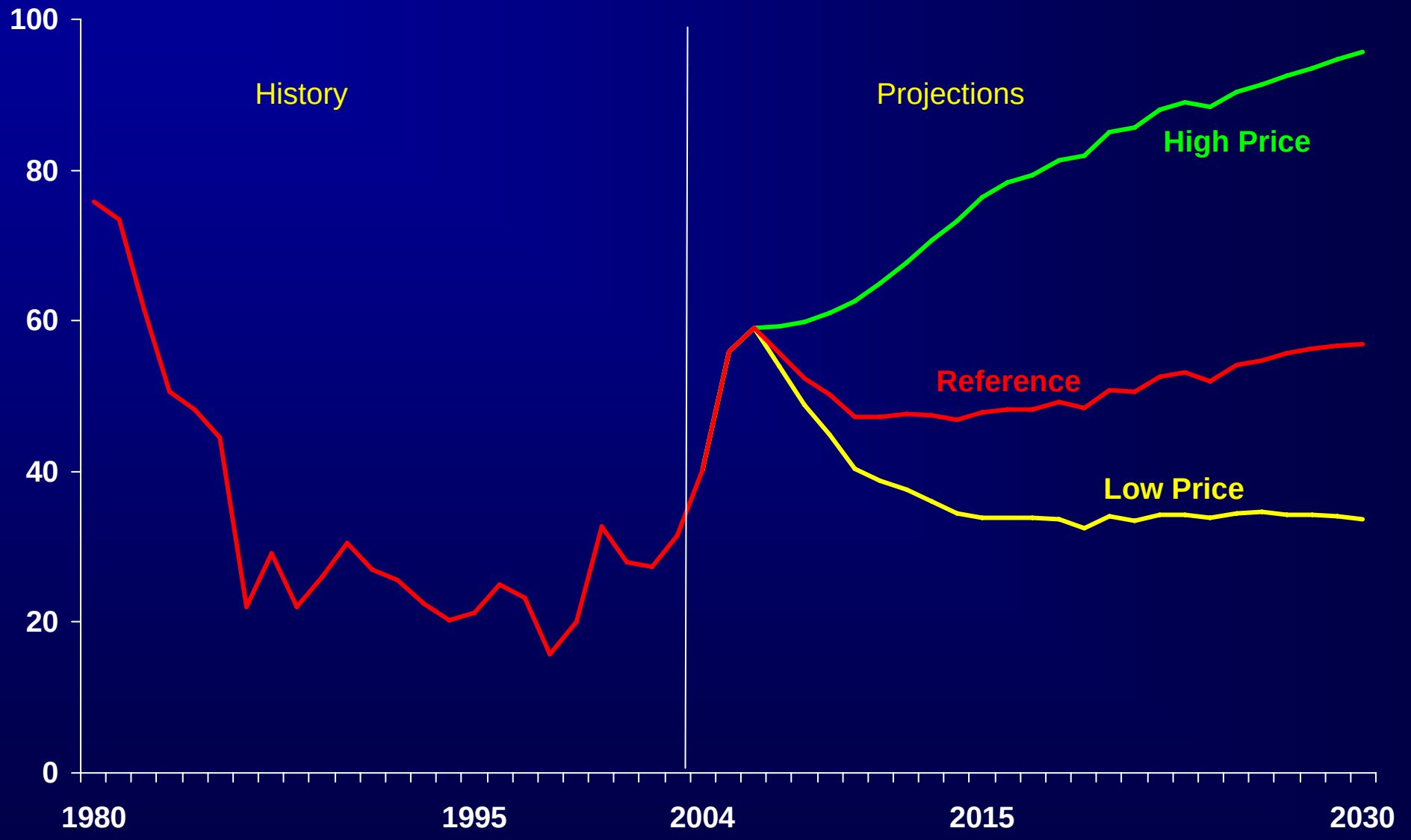
Forms of Technological Progress

- New materials
- New types of equipment
- New knowledge
- New management techniques

Why Technological Progress Is Difficult to Identify and Measure

- Most technological progress is incremental. Small incremental improvements result in large advances over time.
- Technological progress is often intangible, for example, new knowledge and new management techniques.
- Technological progress often originates outside the petroleum industry, for examples, improvements in computer equipment and software.

World Oil Prices, 1980-2030
(2004 dollars per barrel)



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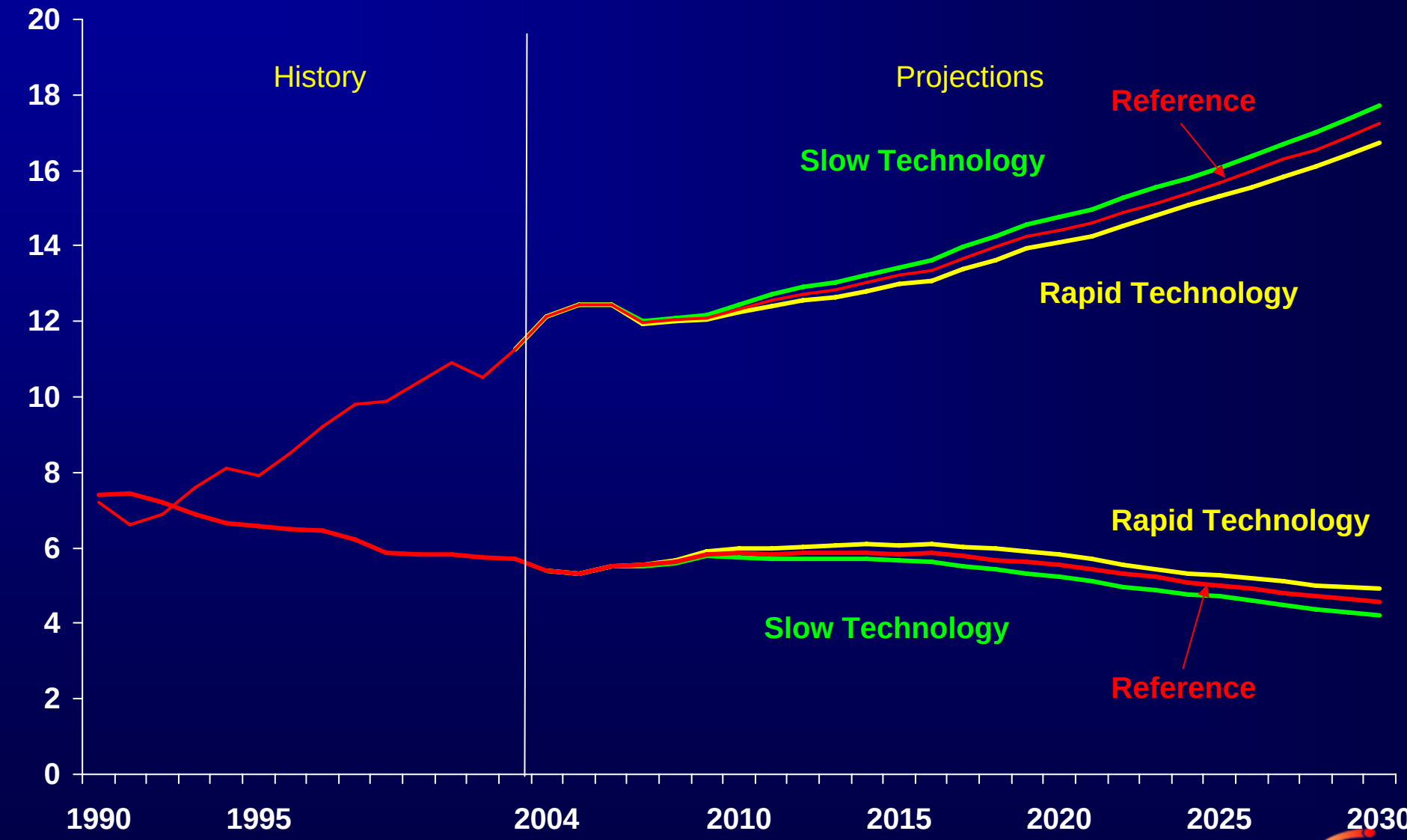
U.S. Crude Oil Production and Net Petroleum Imports, 1990-2030 (million barrels per day)



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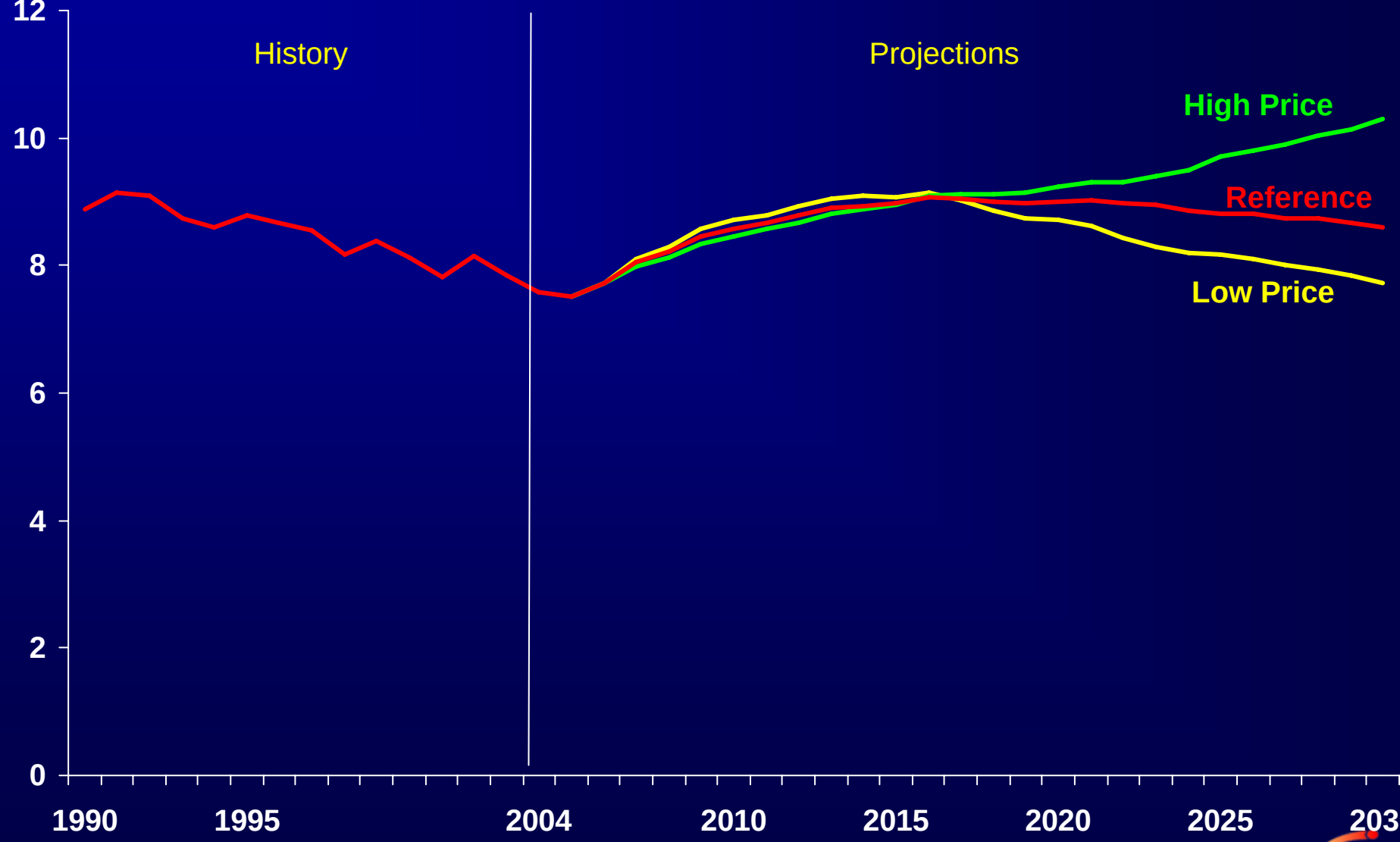
U.S. Total Petroleum Production, 1990-2030 (million barrels per day)



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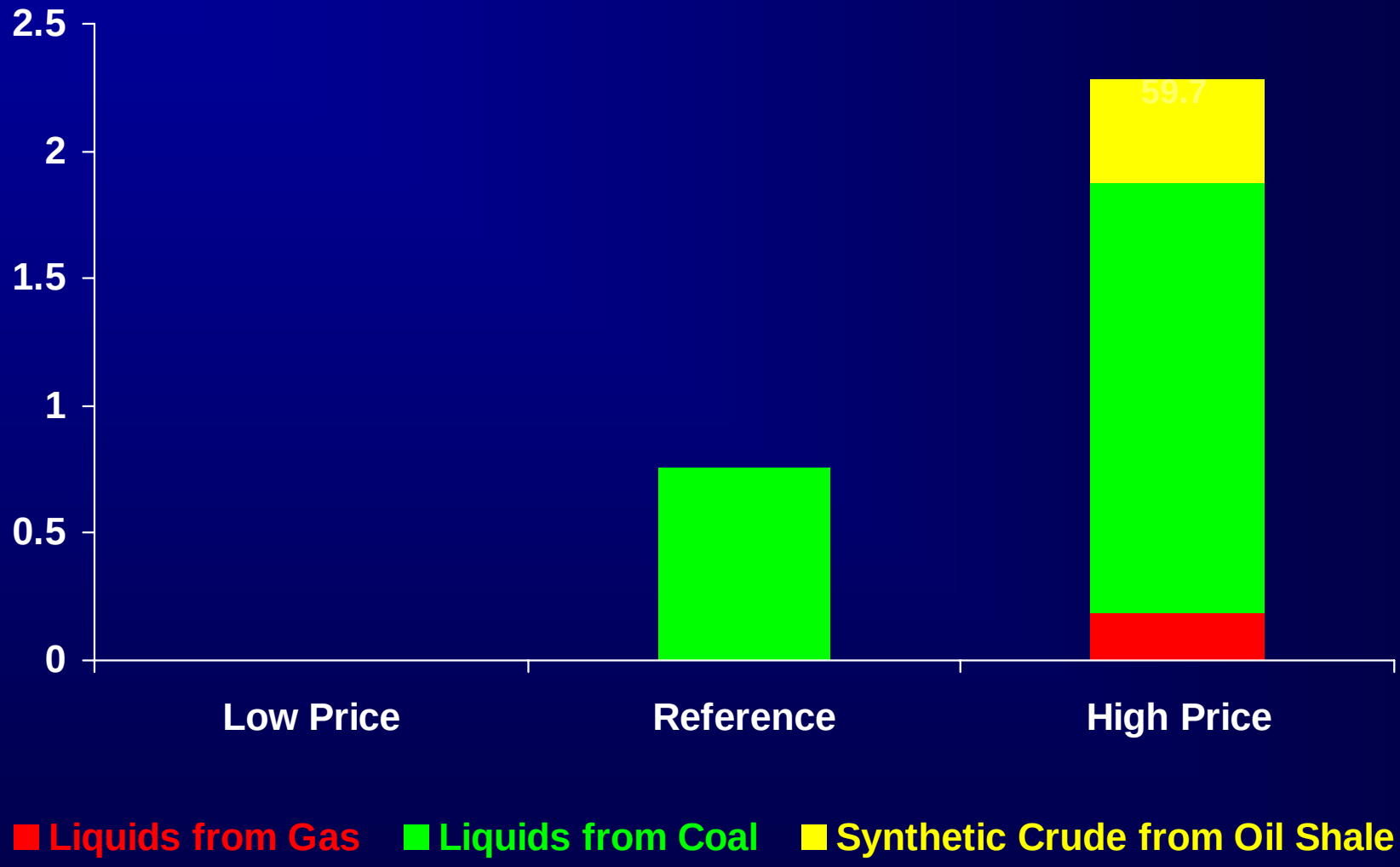
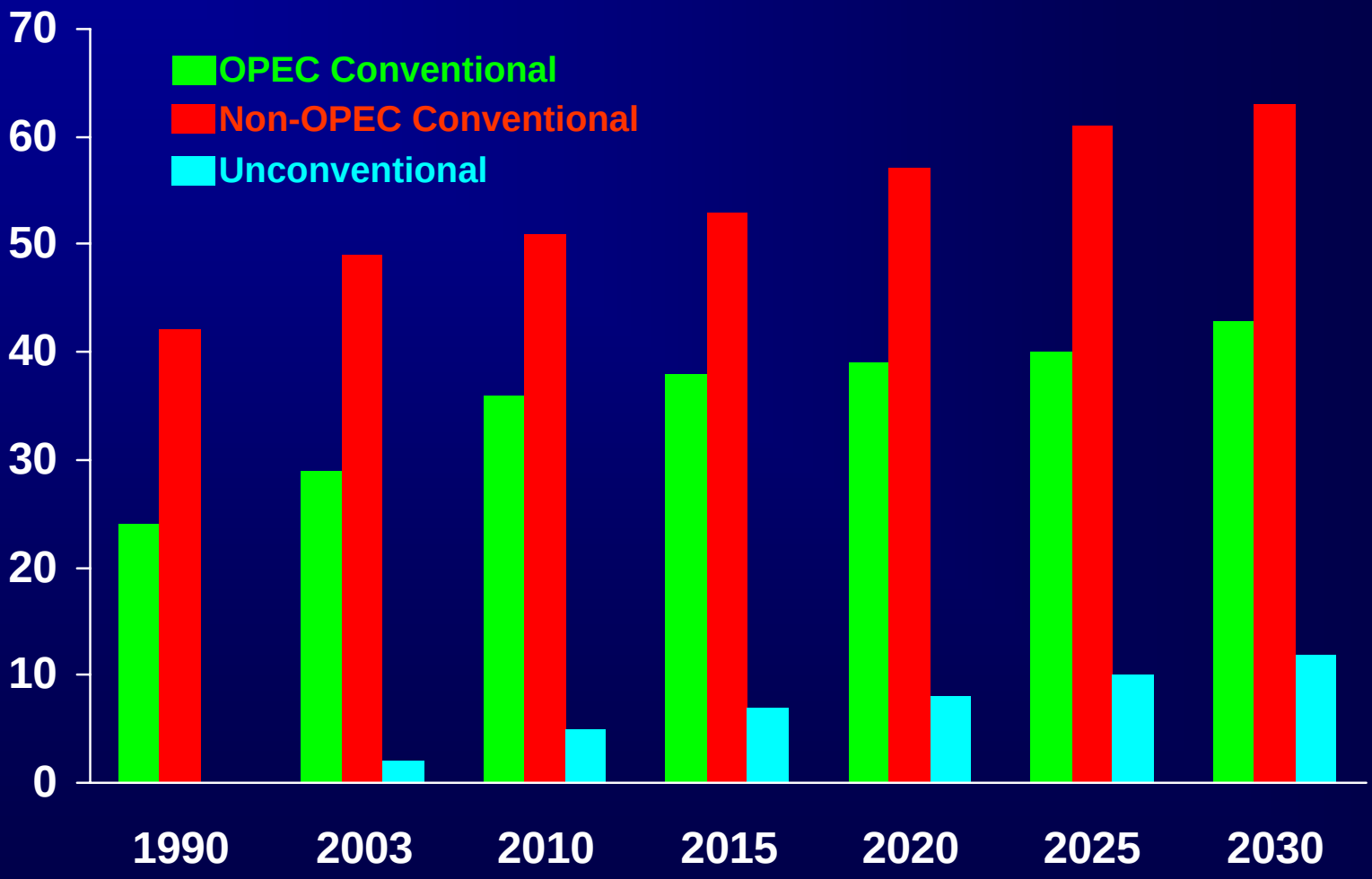
U.S. Unconventional Oil Production, 2030 (million barrels per day)

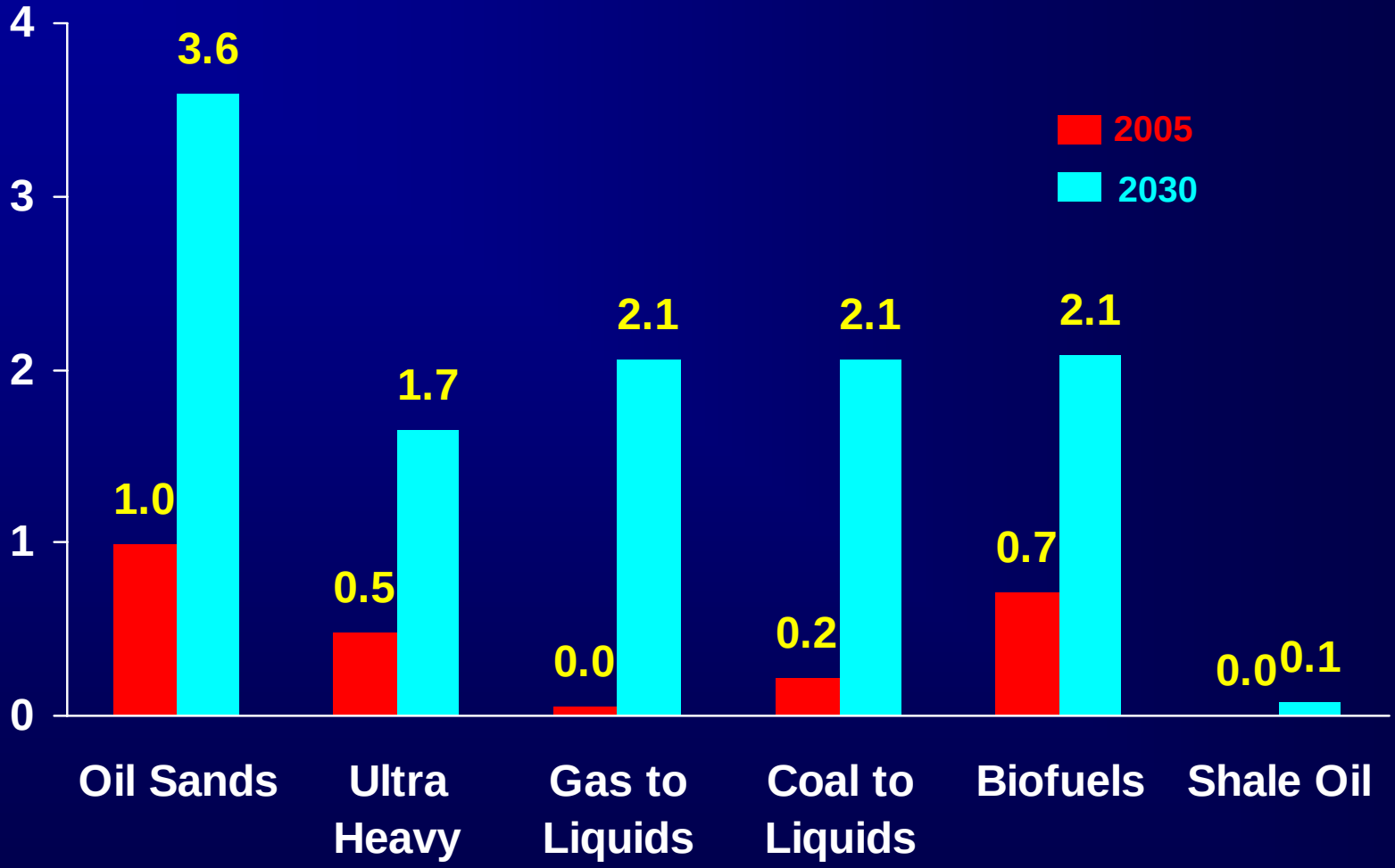


OPEC, Non-OPEC, and Unconventional Oil Production, 1990-2030 (million barrels per day)



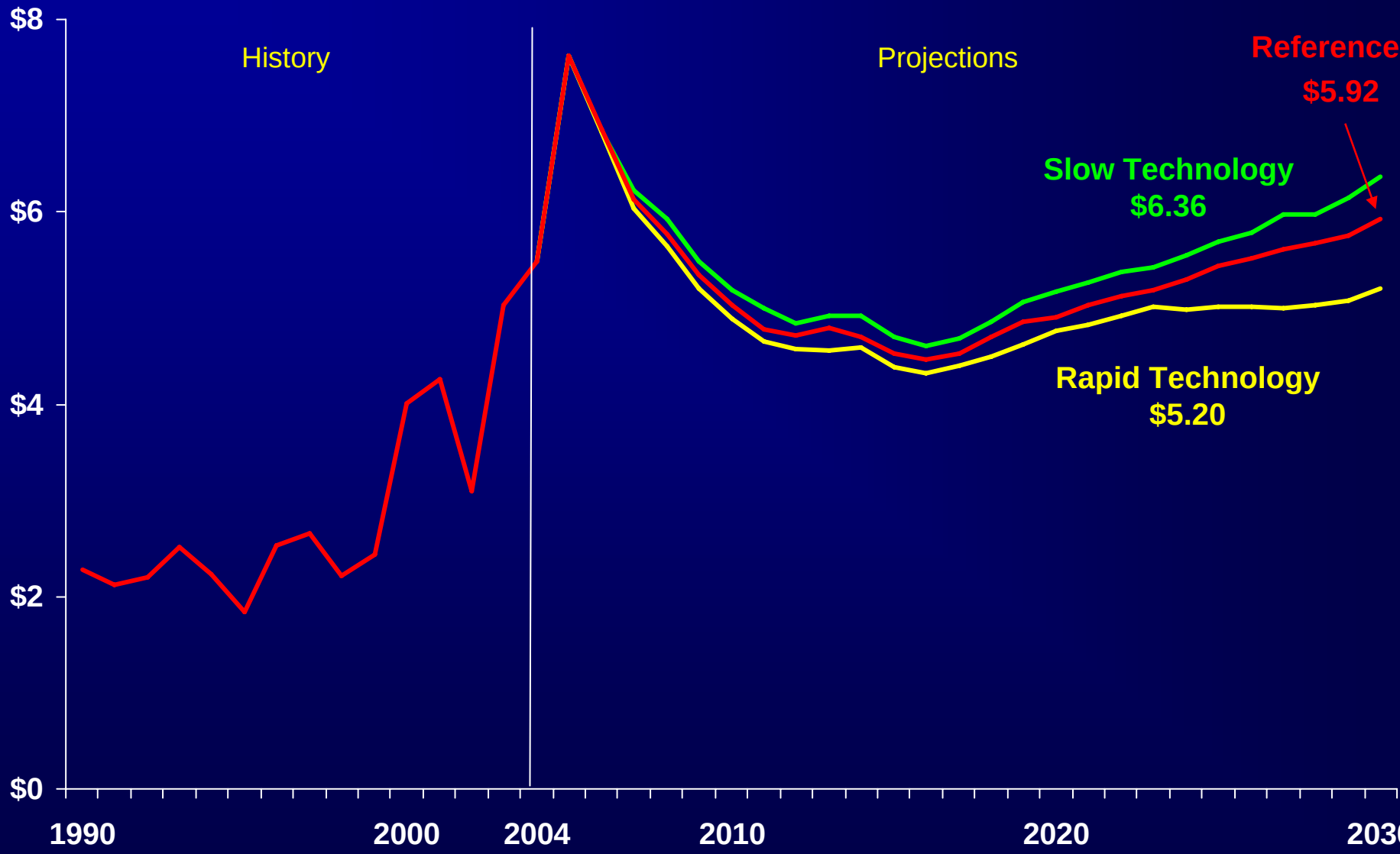
International Energy Outlook 2006

World Unconventional Liquids Production, 2005 and 2030 (million barrels per day)



International Energy Outlook 2006

U.S. Lower-48 Natural Gas Wellhead Prices, 1990-2030 (2004 dollars per thousand cubic feet)



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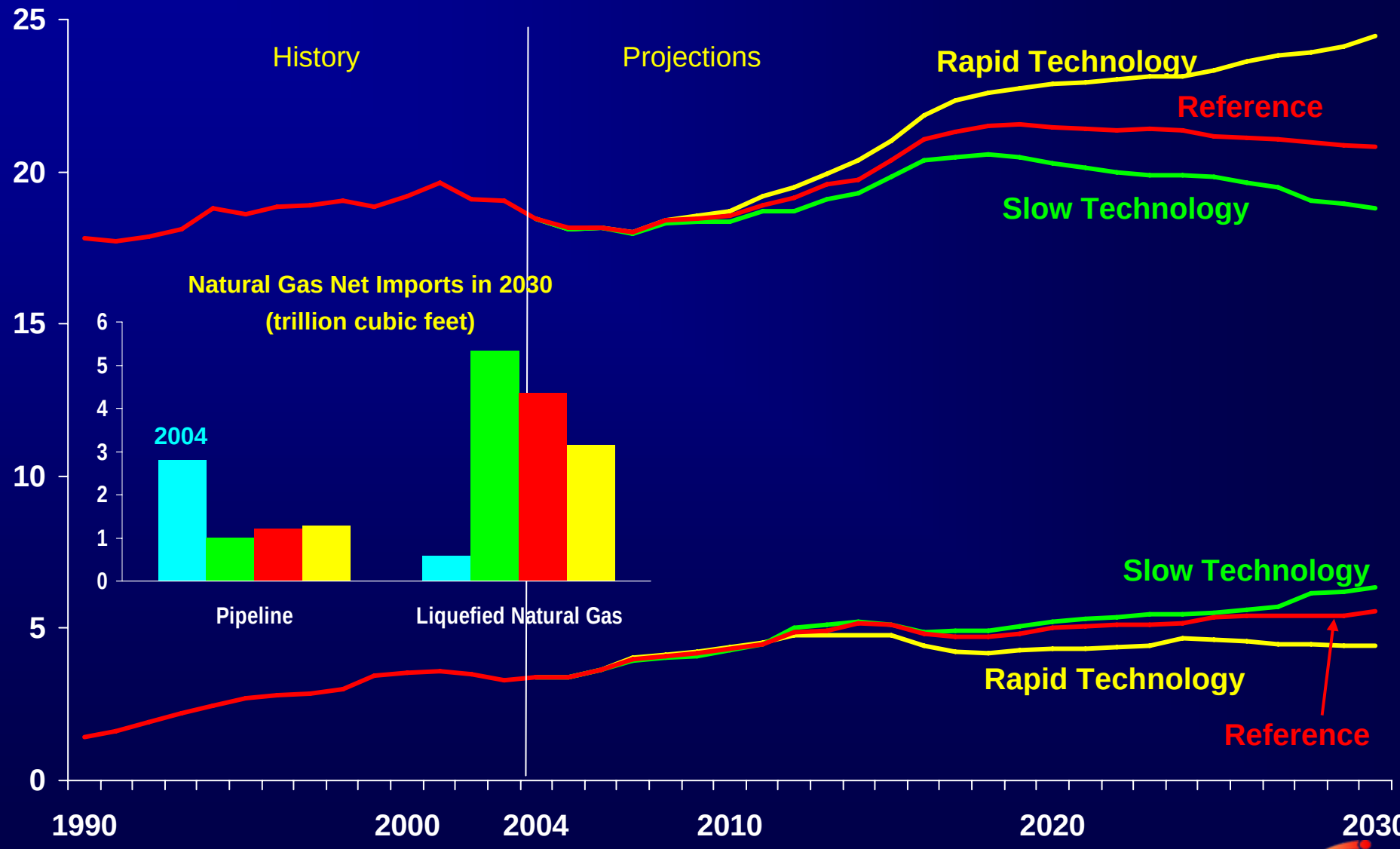
U.S. Natural Gas Production and Net Imports, 1990-2030 (trillion cubic feet)



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U.S. Lower-48 Natural Gas Wellhead Prices, 1990-2030 (2004 dollars per thousand cubic feet)

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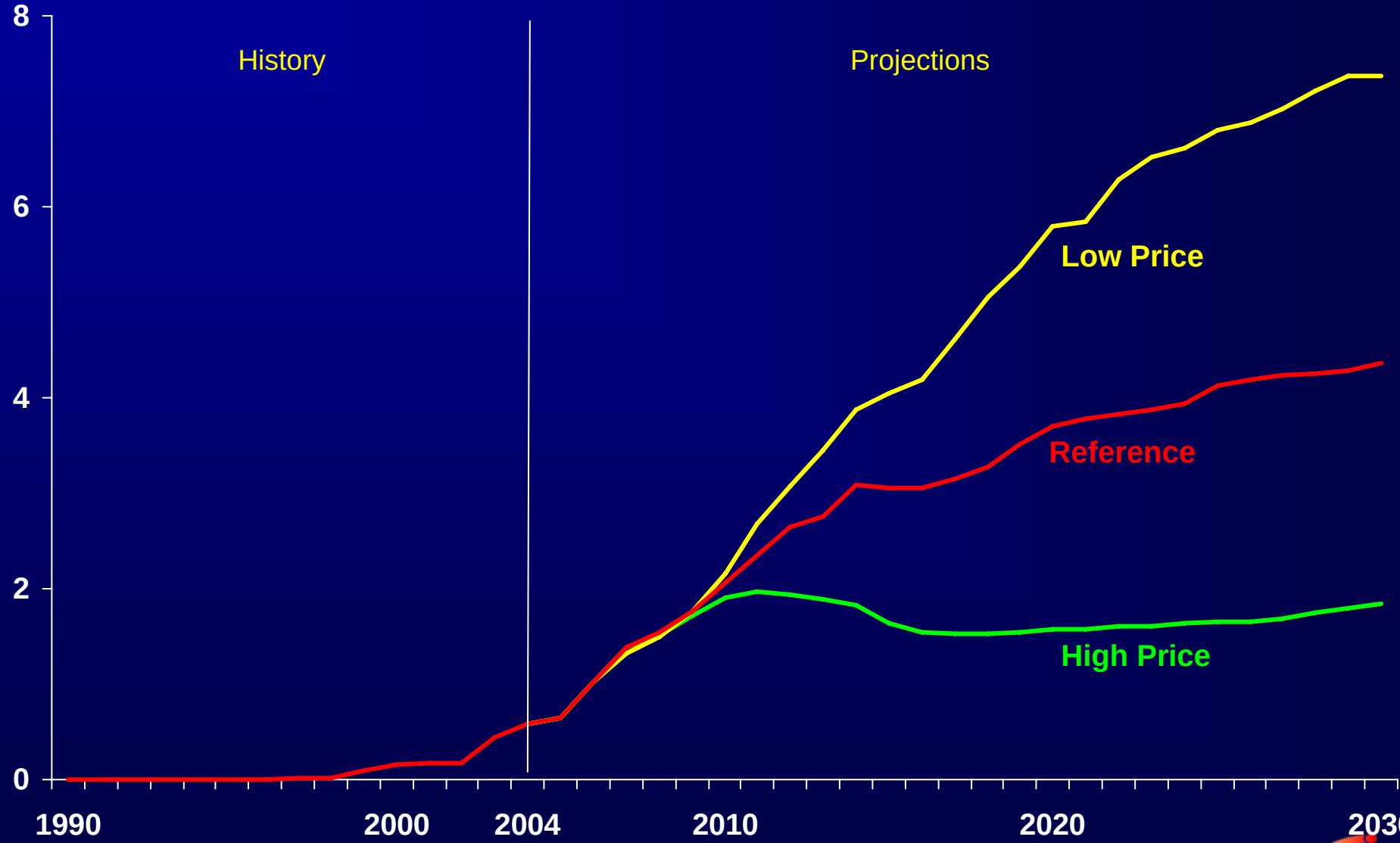
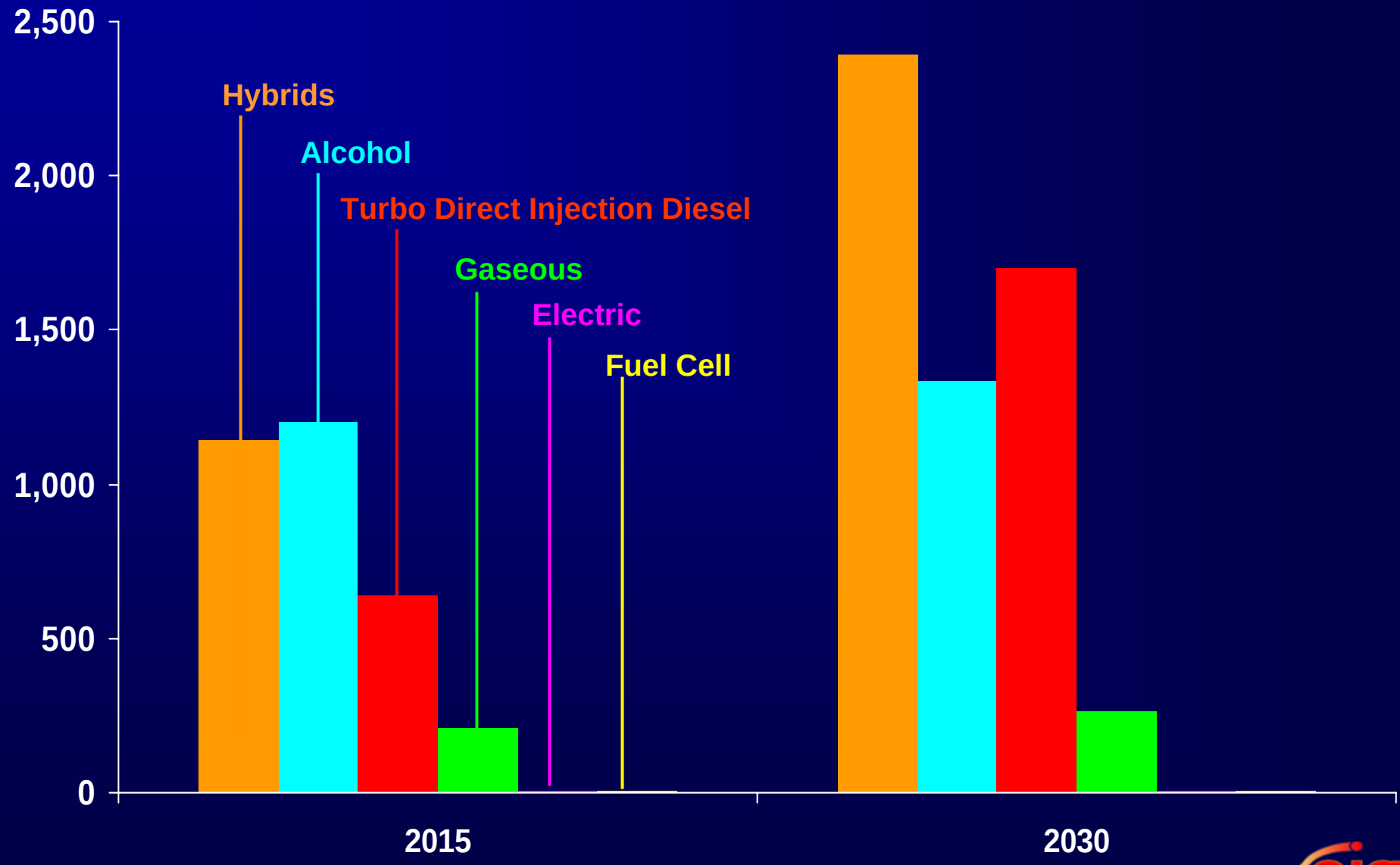
U.S. Net Imports of Liquefied Natural Gas, 1990-2030 (trillion cubic feet)



Sales of Advanced Technology Light-Duty Vehicles, 2015 and 2030 (thousand vehicles sold)



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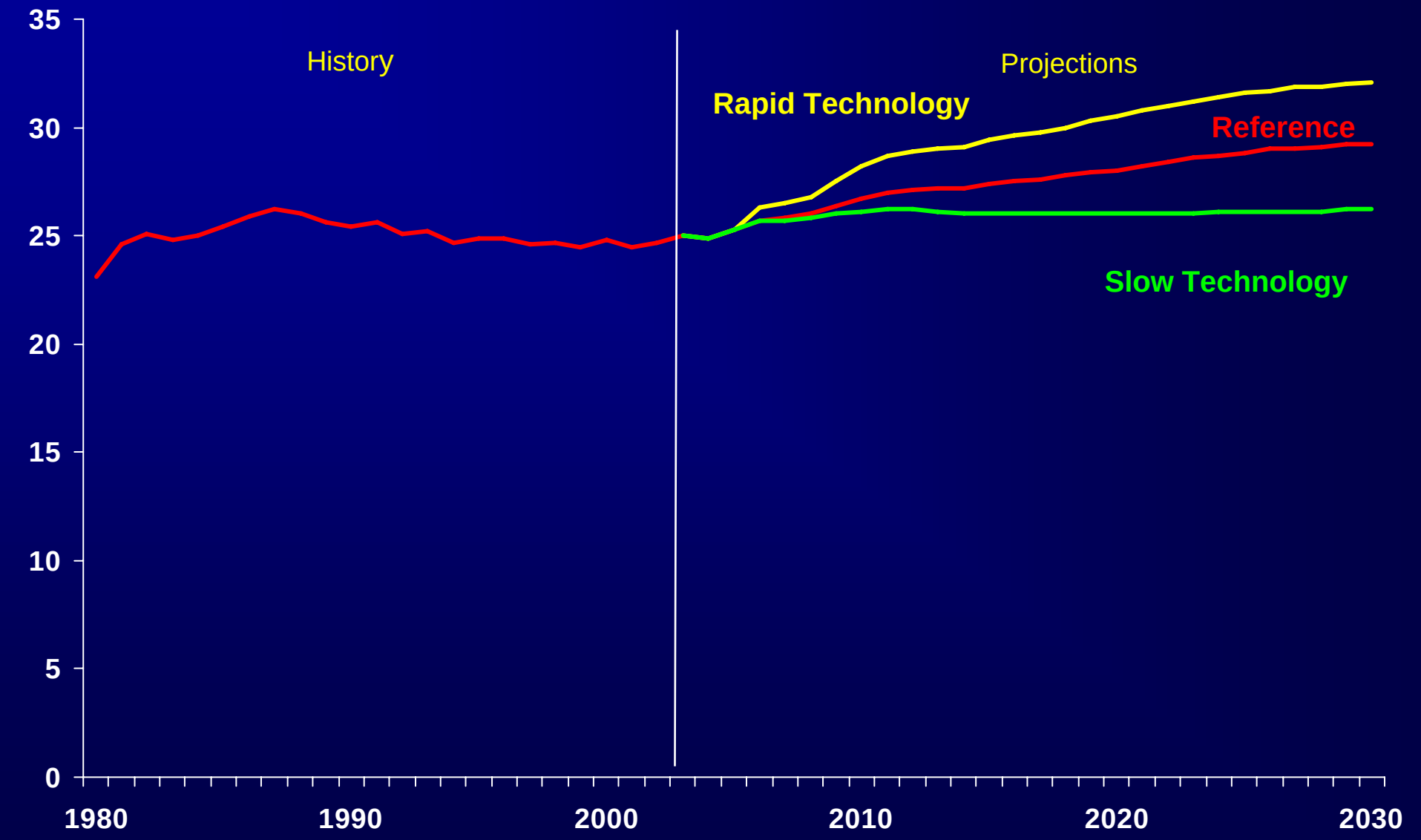
U.S. New Light-Duty Vehicle Fuel Economy, 1980-2030 (miles per gallon)



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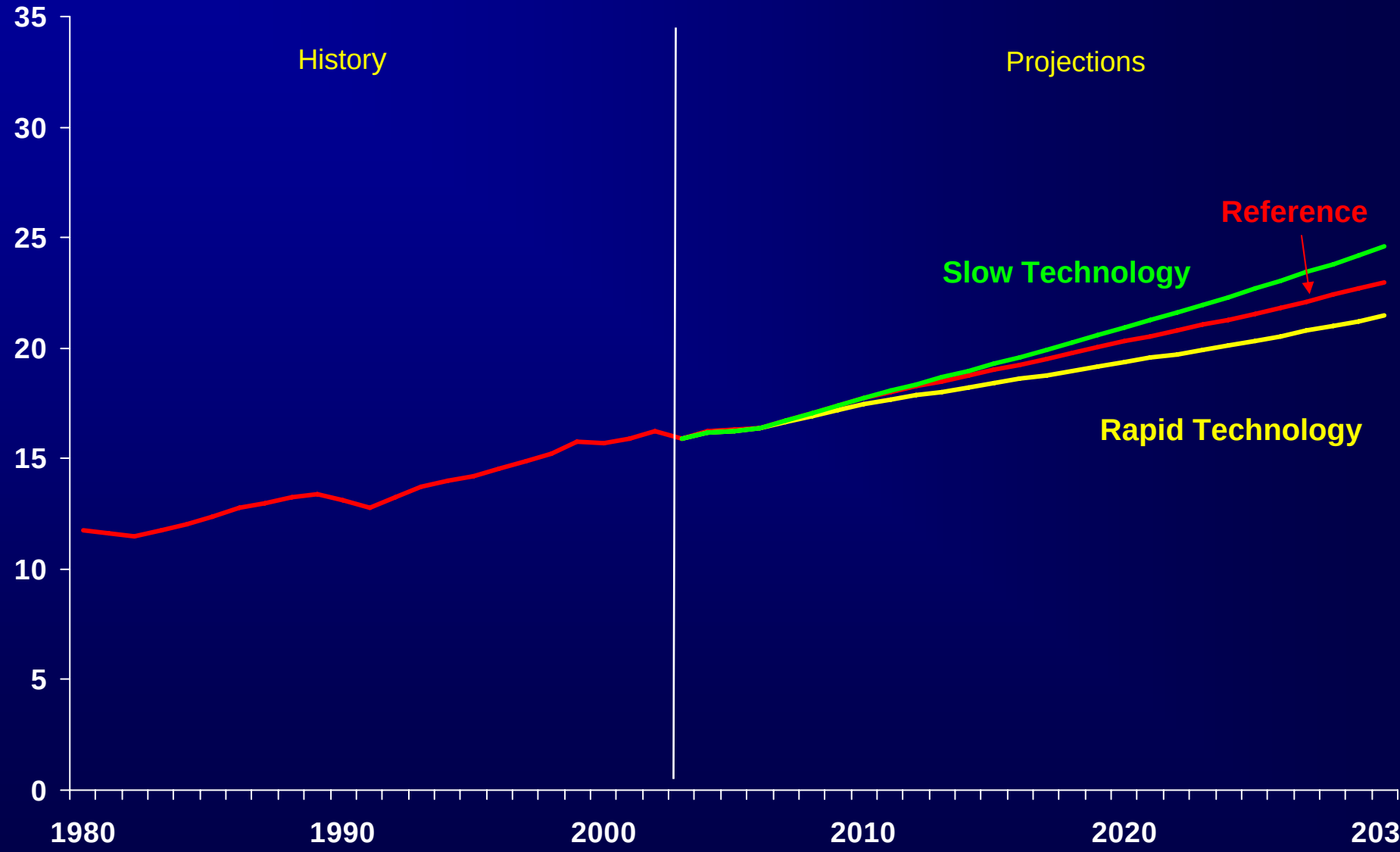
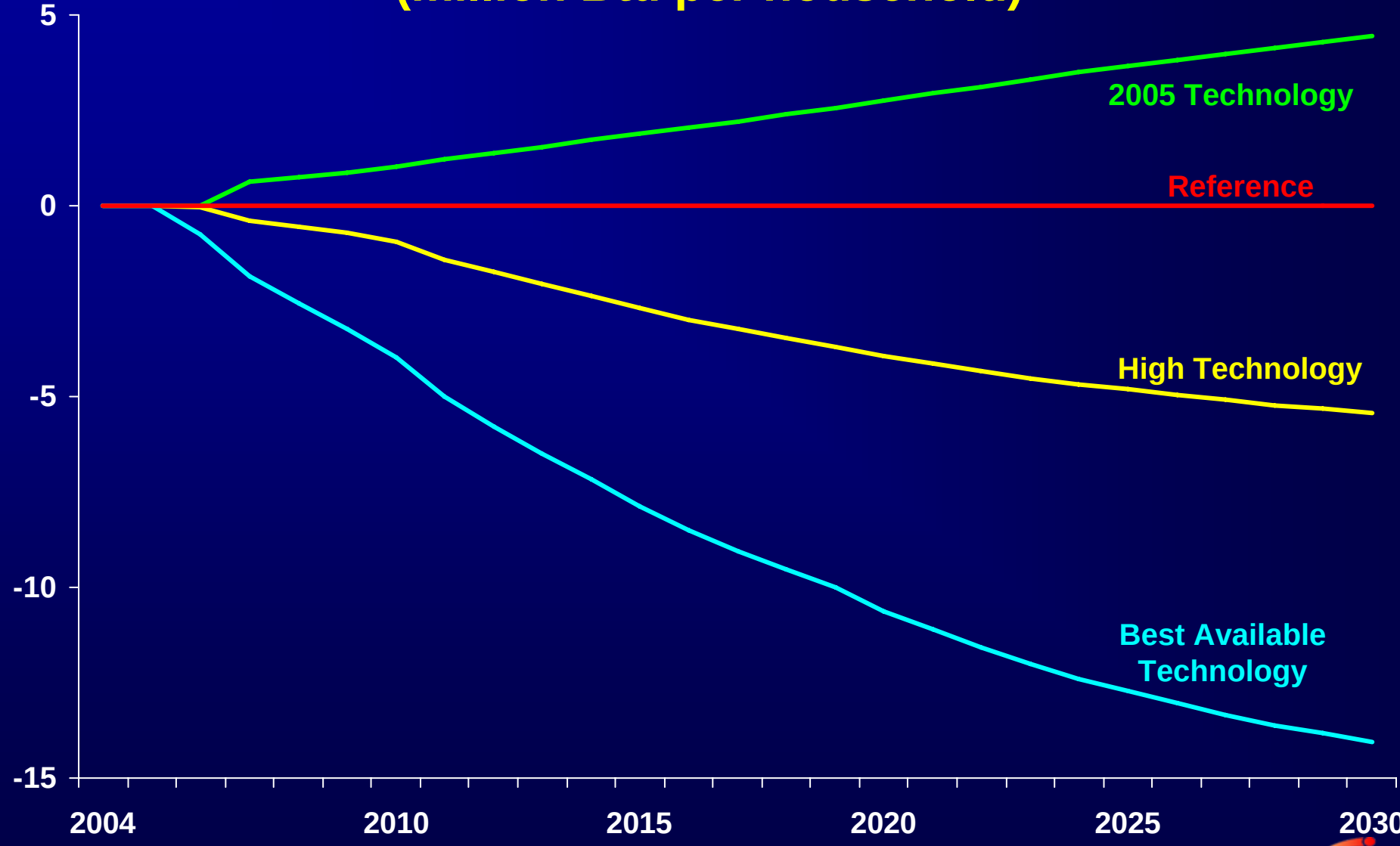
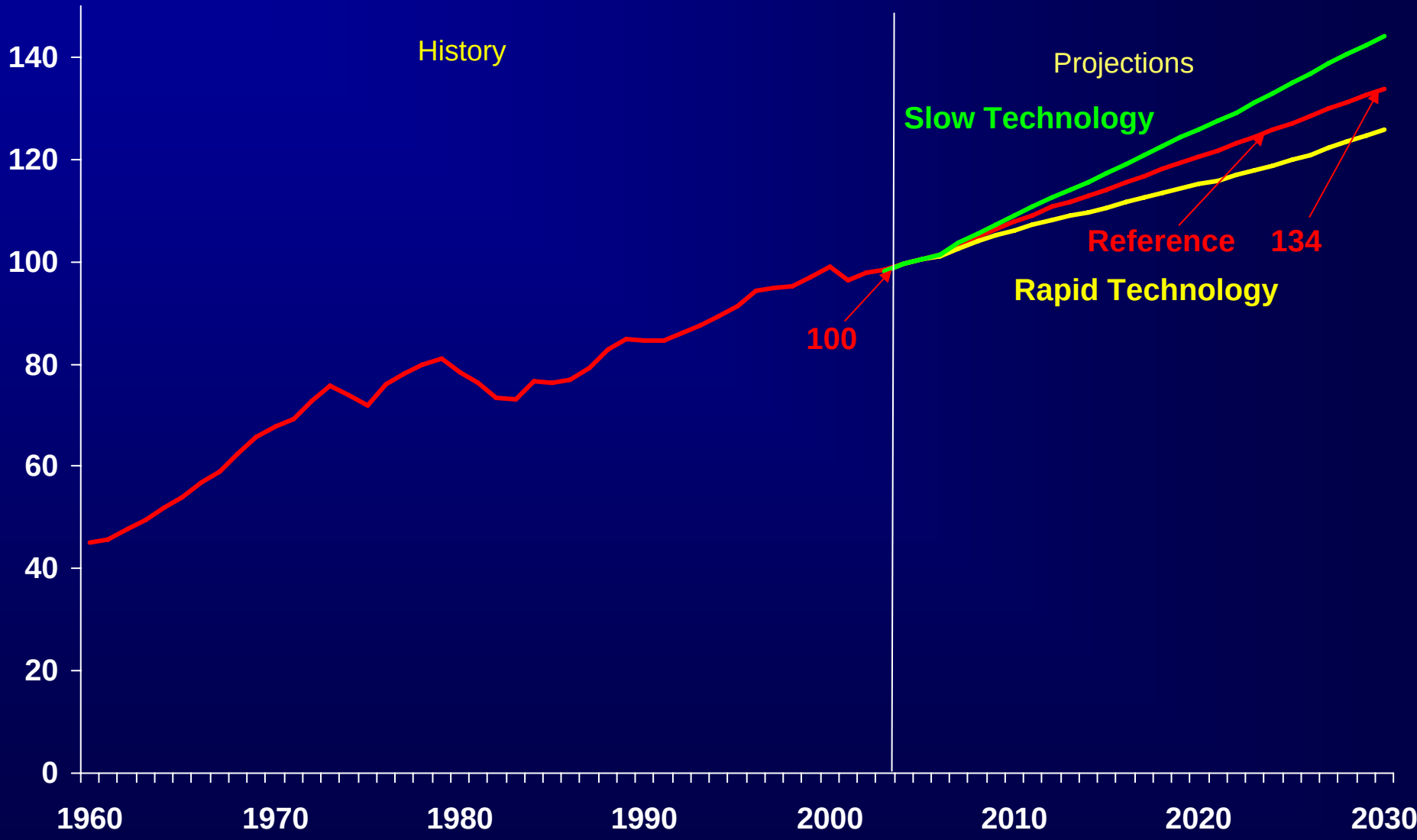
U.S. Light-Duty Vehicle Fuel Consumption, 1980-2030 (quadrillion Btu)



Change in Residential Energy Intensity in Three Cases, 2004-2030 (million Btu per household)



U.S. Primary Energy Consumption, 1960-2030 (quadrillion Btu)



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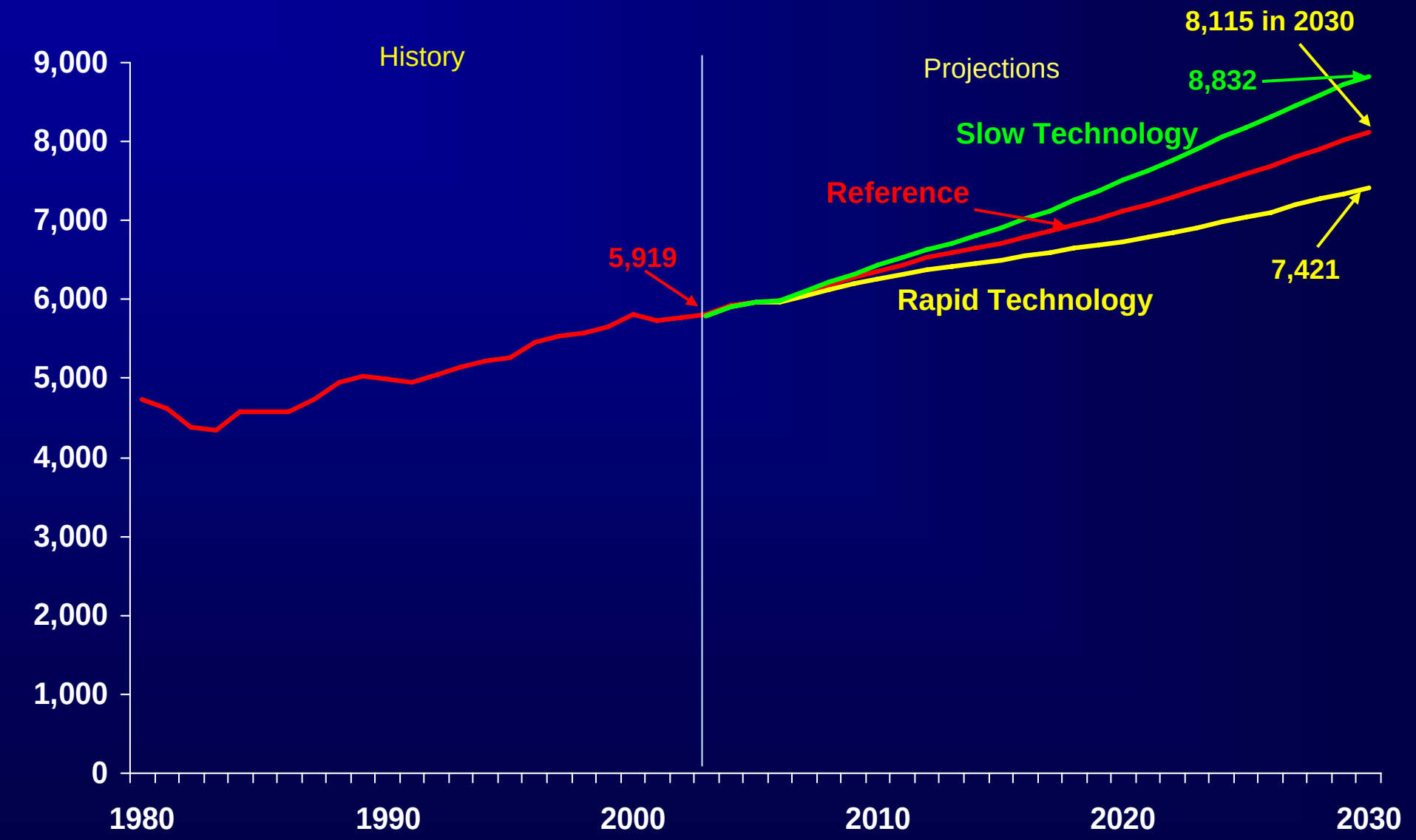
U.S. Energy-Related Carbon Dioxide Emissions, 1980-2030 (million metric tons)



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Technological Progress: The Look Ahead

- Identifying specific breakthroughs is impossible, but advances are likely
- Many of the technology improvements involve the use of existing technologies in more efficient ways
- Major technological developments and opportunities are on the horizon
  - Oil and natural gas supply
  - Transportation
  - Industrial markets
  - Power generation

Periodic Reports

Petroleum Status and Natural Gas Storage Reports, weekly

Short-Term Energy Outlook, monthly

Annual Energy Outlook 2006, February 2006

International Energy Outlook 2006, June 2006

Examples of Special Analyses

"Economic Effects of High Oil Prices," *Annual Energy Outlook 2006*

Analysis of Oil and Gas Production in the Arctic National Wildlife Refuge, March 2004

The Global Liquefied Natural Gas Market: Status and Outlook, December 2003

"Restricted Natural Gas Supply Case," *Annual Energy Outlook 2005*

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